PL-TR-96-2029

NATURAL ENVIRONMENTAL EFFECTS IN MILITARY MODELS AND SIMULATIONS: PART I—A SURVEY OF REQUIREMENTS

Thomas M. Piwowar
John C. Burgeson
Paul D. Try

Science and Technology Corp.
101 Research Drive
Hampton, VA 23666-1340

November 1996

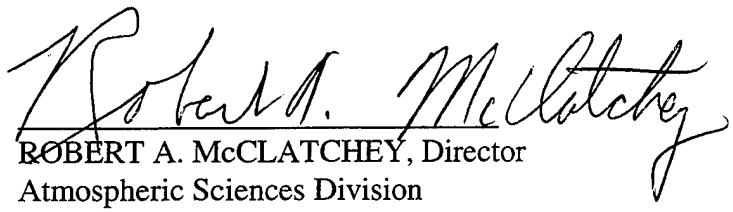
Scientific Report No. 1

PHILLIPS LABORATORY
Directorate of Geophysics
AIR FORCE MATERIEL COMMAND
HANSCOM AIR FORCE BASE, MA 01731-3010

This technical report has been reviewed and is approved for publication.

JAMES METCALF
Contract Manager

DONALD D. GRANTHAM, Chief
Atmospheric Structure Branch



ROBERT A. McCLATCHEY, Director
Atmospheric Sciences Division

This report has been reviewed by the ESC Public Affairs Office (PA) and is releasable to the National Technical Information Service (NTIS).

Qualified requestors may obtain additional copies from the Defense Technical Information Center (DTIC). All others should apply to the National Technical Information Service (NTIS).

If your address has changed, if you wish to be removed from the mailing list, or if the addressee is no longer employed by your organization, please notify PL/IM, 29 Randolph Rd., Hanscom AFB MA 01731-3010. This will assist us in maintaining a current mailing list.

Do not return copies of this report unless contractual obligations or notices on a specific document require that it be returned.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. AGENCY USE ONLY *(Leave Blank)*	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED
	November 1996	Scientific No. 1

4. TITLE AND SUBTITLE
Natural Environmental Effects in Military Models and Simulations: Part I — A Survey of Requirements

5. FUNDING NUMBERS
Contract F19628–95–C–0005
PE 63707F
PR DMSO TAGS WU BA

6. AUTHOR(S)
Thomas M. Piwowar, John C. Burgeson, and Paul D. Try

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)
Science and Technology Corporation
101 Research Drive
Hampton, VA 23666

8. PERFORMING ORGANIZATION REPORT NUMBER
STC Technical Report 2958

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)
Phillips Laboratory
29 Randolph Road
Hanscom Air Force Base, MA 01731–3010
Contract Manager: James Metcalf/GPAA

10. SPONSORING/MONITORING AGENCY REPORT NUMBER
PL–TR–96–2029

11. SUPPLEMENTARY NOTES
The surveys described in this three-part series of reports were developed and conducted under the guidance of the Service representatives of the E^{2}DIS Survey Team: Mr. Donald Grantham, Lead, USAF Phillips Laboratory, Hanscom AFB, MA; Mr. Sam Brand, Naval Research Laboratory, Monterey, CA; and Dr. Alan Wetmore, Army Research Laboratory, Adelphi, MD.

12a. DISTRIBUTION/AVAILABILITY STATEMENT

Approved for public release; distribution unlimited

12b. DISTRIBUTION CODE

13. ABSTRACT *(Maximum 200 words)*
The Defense Modeling and Simulation Office has sponsored the Environmental Effects for Distributed Interactive Simulation (E^{2}DIS) Project, which is composed of eight tasks including the Survey Task. The Survey Task had three objectives: to develop a baseline of the Military Services' current requirements for incorporation of the atmosphere and near-space environment and their effects in military models and simulations (the Requirements Survey), to identify atmospheric and near-space-environment models and databases and environmental effects models that are currently available from the services (the Capabilities Survey), and to compare the results from both survey efforts (the Analysis).

This report, Part I of a three-part series, describes the results of the analysis of the Requirements Survey; Part II describes the results of the analysis of the Capabilities Survey; and Part III describes the results of the comparative analysis of the two surveys . The Requirements Survey identified 208 military models and simulations, whose sponsers provided 78 questionnaires, 74 of which were entered into the database management system. A qualitative and quantitative analysis of the responses to questionnaires is presented in this report, including a case study of wind, the most-required atmospheric data type. Requirements for these specific data are analyzed in terms of their horizontal, vertical, and temporal fidelity. The analysis yielded some unexpected results, especially the lack of requirements for atmospheric effects on forces, platforms, and weapon systems in the 74 surveyed military models and simulations. The Survey Team concluded from its analysis that a strong need exists for collaboration between the environmental science and support community and the military's modeling and simulation community.

14. SUBJECT TERMS
Capabilities Survey, atmospheric effects, Defense Modeling and Simulation Office (DMSO), Environmental Effects for Distributed Interactive Simulation (E^{2}DIS), Military Services, modeling and simulation (M&S), natural environment, near-space-environment effects, Requirements Survey

15. NUMBER OF PAGES
278

16. PRICE CODE

17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	SAR

CONTENTS

LIST OF FIGURES

LIST OF FIGURES (Concluded)

Page

LIST OF TABLES

LIST OF ACRONYMS

DIS	Distributed Interactive Simulation
DMSO	Defense Modeling and Simulation Office
DoD	Department of Defense
E^2DIS	Environmental Effects for Distributed Interactive Simulation
M&S	Modeling and Simulation
MEL	Master Environmental Library
QBE	Query By Example
VV&A	Verification, Validation, and Accreditation

EXECUTIVE SUMMARY

The Defense Modeling and Simulation Office (DMSO) has sponsored the Environmental Effects for Distributed Interactive Simulation (E^2DIS) Project. This effort is a multiagency project that includes scientists primarily from the research laboratories of the Military Services. From a management perspective, the E^2DIS Project consisted of eight tasks, including the Survey Task. The lead service laboratory for the Survey Task Team was the Air Force Phillips Laboratory, assisted by the Army Research Laboratory and the Naval Research Laboratory.

The E^2DIS Project's Survey Task was established in part to develop a baseline of the Military Services' current requirements for incorporating the atmosphere and near space environment and their effects in military models and simulations. This was the Survey Team's first task assignment, routinely called the "Requirements Survey." In addition, the Team was charged with identifying atmospheric and near-space-environment models and databases, and effects models and databases that are currently available from the Services. This second effort has been known as the "Capabilities Survey." The third task for the Survey Team was to compare the results from both survey efforts and make appropriate recommendations. Another purpose of the Survey Task has been, in a support role, to provide the E^2DIS Project-level management personnel with information for their use in better guiding the project to meet the needs of the sponsor, the DMSO, and the Military Services' modeling and simulation (M&S) community.

This report, the first in a three-part series, documents the results and findings from the Requirements Survey. A complementary report documents the results from the Capabilities Survey. The third report contains a comparison and an assessment of the results of both surveys.

The Survey Team developed and implemented a strategy to conduct both the Requirements Survey and the Capabilities Survey. This strategy's approach included identifying task drivers for the surveys, developing an execution plan, and implementing that plan. The major task drivers for the Requirements Survey were (1) the scope of the Survey Task, (2) the scope of the Services' M&S efforts, (3) the critical environmental factors for military models and simulations, and (4) the value to the warfighter.

Of the 208 military models and simulations that were identified during the course of the Requirements Survey effort, the Survey Team received questionnaires for 77 models and simulations. The Team quality-controlled these 77 questionnaires in two ways: in a gross sense, by considering each

questionnaire's relevance to the Requirements Survey; and, in a detailed sense, by considering the quality of answers to specific questions in each questionnaire. The quality control effort included personal, telephonic, and electronic interviews with the technical expert for each model or simulation. The net result was that information from 74 questionnaires was entered into the Requirements Survey database, and the remaining three questionnaires were assigned to the Capabilities Survey.

The Survey Team has analyzed the Requirements Survey data contained in the database and presented results in aggregate for the 74 military models and simulations. This quantitative analysis not only provides technical details on the current requirements for atmospheric and near space environment in military models and simulations, but it also provides some unexpected and, in some cases, surprising results associated with these requirements. From the quality control interviews with the technical experts for the models and simulations, as well as meetings, briefings, and documentation reviews that the Survey Team conducted, some important qualitative findings are also identified.

The quantitative analysis begins with developing a distribution of the 74 models and simulations identifying their relationship with functional (or mission) areas established by the DMSO and with an Air Force-provided hierarchy of models and simulations. The DMSO functional areas are Research and Development; Test and Evaluation; Analysis; Production and Logistics; and Military Operations, Training, and Education. The Air Force hierarchy of models and simulations range from the small-scale engineering, or subsystem, level to the large-scale Campaign level. This initial analysis is done to show the general character of the sample set of military models and simulations included in the survey's database. Given that requirements data for 74 models and simulations have been entered in the database, the Survey Team, after reviewing the functional-area-versus-hierarchical-level matrix showing the distribution, is satisfied that a reasonable set of models and simulations has been sampled.

Of the 74 military models and simulations, respondents identified 54 as having critical environmental factors, such as factors affecting thermal imagery of targets and radio frequency path loss. **One of the unexpected and interesting results is that only 60 percent (9 of 15) of the Military Operations models and simulations were identified as having critical environmental factors.**

Most models and simulations surveyed are operational, or will be by FY-97. About 60 percent of the models and simulations surveyed are virtual, while 28 percent are constructive, and 11 percent are for

live play. Forces, platforms, weapon systems, and sensors are modeled by approximately 60 percent of the models and simulations, 46 percent of which model communication systems.

Another unexpected and rather surprising result is that 41 percent (i.e., 30) of the models and simulations do not have current requirements for atmospheric data. For those that do require atmospheric data, wind is the most required data type—required by 45 percent (33 of the 74 total) of the models and simulations, or 75 percent of those 44 that require any type of atmospheric data. Aerosols, clouds, fog, precipitation, temperature, and visibility are required by approximately 30 to 39 percent of the 74 models and simulations. Resolution requirements for atmospheric data generally show a preference for 100 m and 10 km in the horizontal, 100 m in the vertical, and 1-hr time intervals.

Although 59 percent (44 of 74) of the models and simulations surveyed have requirements for some type, or types, of atmospheric data, there is almost a complete lack of identified requirements for any atmospheric effects on forces, platforms, and weapon systems. Less than 15 percent of the models and simulations incorporating forces, platforms, or weapon systems have been identified to have requirements for atmospheric effects. **This is probably the survey's most striking and unexpected result.**

For the near space environment, only a few models and simulations have identified requirements. Only seven models and simulations have current requirements, and three more have potential requirements. The dominant data type among the seven with current requirements is "solar parameters," i.e., solar position, solar radiative flux, sunspot activity, and solar index. Resolution requirements were identified for only the time dimension; no meaningful distribution is apparent since only two time resolution requirements were specified. Three near-space-environment effects requirements were identified for platforms, communication systems, and sensors.

For software compatibility requirements, UNIX operating systems dominate; C, FORTRAN, Ada, and C++ dominate the programming language requirements. For host hardware requirements, no system clearly dominates: SGI, VAX, and SPARC hardware are required more than others. A majority of the models and simulations have requirements for transportability.

"Secret" is the most frequently stated requirement for the maximum security level planned for environmental data. Forty-eight percent of those responding indicated a requirement for secret data. Less than 30 percent of the models and simulations have stated requirements for verification, validation, and

accreditation of environmental data. Twenty-five respondents indicated a requirement for reasonably current, real-world environmental data for use in their model or simulation.

A case study focused on the most required atmospheric data type—wind—its relationships and applications. About 60 percent of the Research and Development models and simulations have current requirements for the wind atmospheric data type, but only 26 percent of Analysis and 36 percent of Military Operations models and simulations have requirements for this data type. **A surprising and unexpected result is that none of the nine Campaign-level models and simulations require the wind atmospheric data type**. And, **only three of the eight live play models and simulations have requirements for the wind atmospheric data type, a perplexing and counterintuitive result**. For those models and simulations incorporating forces, platforms, or weapon systems, the wind atmospheric data type is typically required, but atmospheric effects are not. This is another perplexing result. Resolution requirements for the wind data type, in terms of horizontal, vertical, and time dimensions, match very closely the resolution requirements for the aggregated set of all atmospheric data types.

Four significant findings, qualitative in nature, were discovered during the Requirements Survey effort: (1) lists of major M&S efforts in each service were not available to the Survey Team; (2) the need for increasing the M&S community's awareness of the natural environment and its effects on military forces, platforms, weapon systems, sensors, and communication systems became evident; (3) a simple conceptual diagram showing the relationships of environmental effects, environmental models and databases, and warfighting models, and an authoritative set of definitions for environmental effects and environmental impact were needed for many of the interviews with technical points-of-contact; and (4) models and simulations have implicit, as well as explicit, requirements for environmental data.

To partially offset the lack of an authoritative list, the Survey Team compiled its own *ad hoc* list of major models and simulations and coordinated it with each of the Services. The composite set of interviews, meetings, and briefings with technical experts yielded the second finding concerning awareness. Some notable exceptions to this general finding statement about awareness do exist, but they are few in number—the Survey Team estimates that less than 10 percent of those interviewed and briefed were reasonably knowledgeable about the environment and its effects. The Team developed its own simple tool to diagram conceptually the relationships mentioned in the third finding above. In addition, a set of definitions for environmental effects and environmental impact was developed to complement the diagram. The fourth finding occurred when one of the Survey Team members reviewed technical documents

describing a theater-level warfighting model. Implicit requirements[1] for environmental effects data and environmental data were found in several algorithms, for example, in those that calculate the probability of air defense radars detecting incoming air targets.

Based on the results and findings from the E^{2}DIS Project Requirements Survey, the Survey Team recommends eight issues for further research, including the issue of why there are so few requirements for atmospheric effects for forces, platforms, and weapon systems in the military models and simulations surveyed. The Survey Team also presents five issues for resolution, including the need to institutionalize an approach for identifying requirements for atmospheric and near-space-environment effects and data. Finally, the Team recommends that the Military Services' environmental science and support community provide briefings to questionnaire respondents who indicated an interest for a briefing on atmospheric and near-space-environment data types, effects, processes, and features.

[1]By implicit requirements it is meant that the algorithms, although not explicitly requiring any environmental effects or environmental data, nonetheless have at least one factor (e.g., radar range) that is directly dependent upon the physical state of the environment. In the case of radar range, there is an implied requirement for atmospheric effects; that is, the effects that some assume atmosphere has on propagating radar energy. To characterize such an assumed, or implied, atmosphere requires a set of atmospheric data (e.g., temperature, water vapor, and precipitation data).

FOREWORD

Science and Technology Corporation (STC) is please to submit this report "Natural Environmental Effects in Military Models and Simulation: Part I – A Survey of Requirements," written by Mr. Thomas M. Piwowar, Mr. John C. Burgeson, and Dr. Paul D. Try. It is intended for the military modeling and simulation community and the environmental support community. The surveys described in a three-part series of reports were developed and conducted under the guidance of the Service representatives of the E^2DIS Survey Team: Mr. Donald Grantham, Lead, USAF Phillips Laboratory, Hanscom AFB, MA; Mr. Sam Brand, Naval Research Laboratory, Monterey, CA; and Dr. Alan Wetmore, Army Research Laboratory, Adelphi, MD. The E2DIS Survey Team wishes to extend their thanks to the following personnel who assisted them in the Requirements Survey effort: Dr. Harry Heckathorn, Program Manager, Environmental Effects on Distributed Interactive Simulation (E^2DIS); Mr. Isiah Sheperd, Defense Modeling and Simulation Office; Colonel D. Hardin, USA, Chief of the Army's Modeling and Simulation Management Office; Lieutenant Colonel J. Lanicci, USAF, Headquarters, Air Staff (AF/XOM); Captain L. Bryant, USMC, Marine Corps Modeling and Simulation Management Office; and Mr. G. Phillips, Office of the Chief of Naval Operations.

1. INTRODUCTION

During the past few years, a growing interest has developed in the Department of Defense (DoD) regarding modeling and simulation (M&S). Leaders in DoD share a special interest in ensuring that military models and simulations are both realistic and relevant. One technical area that has received considerable emphasis is the **natural environment**—the terrain, atmosphere, ocean, and space environment. The Defense Modeling and Simulation Office (DMSO), in particular, has been a leader in this regard by sponsoring and funding several projects that are seeking to improve the simulation of representations of the natural environment for a variety of military M&S applications.

1.1 BACKGROUND

One such natural environment project initiated by the DMSO in FY-93 is the Environmental Effects for Distributed Interactive Simulation (E^2DIS) Project (Heckathorn, 1994; Naval Research Laboratory, 1994 and 1995). This is a multiagency project under the management lead of the Naval Research Laboratory, Washington, DC. The E^2DIS Project includes scientists from research laboratories of the Military Services. From a management perspective, the E^2DIS Project is composed of eight tasks, one of which is the Survey Task. The lead service laboratory for the E^2DIS Project's Survey Task is the U.S. Air Force Phillips Laboratory, Geophysics Directorate, Hanscom Air Force Base, Massachusetts. Army and Navy scientists from the Army Research Laboratory, Battlefield Environment Directorate, White Sands Missile Range, New Mexico, and from the Naval Research Laboratory, Marine Meteorology Division, Monterey, California, respectively, are assisting Phillips Laboratory in managing the Survey Task.

1.2 PURPOSE

The E^2DIS Project's Survey Task was initiated to baseline the current situation regarding incorporation of the atmosphere and near space environment, and the effects of these natural environments, in military models and simulations. The Survey Task effort was also charged with identifying potential future requirements for incorporating the atmosphere and near space environment, and their effects, in these models and simulations. Another purpose of the surveys was to provide information to E^2DIS Project-level management personnel for their use in better guiding the project to meet the needs of the sponsor, the DMSO, and the Military Services' M&S community.

A priori, the E^2DIS Project assumed that some shortfalls or deficiencies might be experienced in incorporating the natural environment. Therefore, the Survey Task Team was assigned the additional

responsibilities of (1) identifying and cataloging environmental models, environmental effects models, and databases that might be useful in realistically representing the atmosphere and near space environment; and, (2) assessing the capabilities of these environmental models and databases and environmental effects models versus the requirements for incorporating the atmosphere and near space environment in military models and simulations. This report, the first in a three-part series, presents the results of the initial requirements baselining effort only. Two subsequent reports, originated by the E^{2}DIS Project's Survey Task, will present the results of the cataloging (Burgeson et al., 1996a) and assessment efforts (Burgeson et al., 1996b).

1.3 SCOPE

One of the first key steps for any project or task is to determine the scope, or constraints, of the effort desired. From a management and organizational perspective, the E^{2}DIS Project's Survey Team concluded early-on that the focus of its efforts should be directed toward the Air Force, Army, Marine Corps, and Navy M&S activities. For the technical scope of its effort, the Survey Team was specifically assigned to focus on the atmosphere and near space environment only. In addition, the Survey Team felt that the requirements survey's technical scope should include nondistributed, stand-alone M&S efforts, as well as distributed modeling and simulation activities.

It should be noted that modeling and simulation database requirements for the terrain portion of the natural environment were already surveyed and documented under the aegis of an earlier DMSO-sponsored project led by the Defense Mapping Agency (1993). Ocean requirements for military models and simulations are being identified by another DMSO-sponsored project, the Master Environmental Library (MEL) Project (Siquig et al., 1995). Survey Team members have coordinated with both DMSO projects to avoid duplicating survey efforts. This Team has also assisted with the MEL Project by including two questions in the E^{2}DIS Project's Survey Requirements Questionnaire that inquire, in part, about horizontal and vertical domain requirements for the oceanic environment. Responses to these questions are being used in the MEL Project to help identify candidate models and simulations.

2. SURVEY STRATEGY

The E^2DIS Project Survey Team determined that careful planning was critical to achieving success with its survey efforts. During the planning phase, a basic approach was identified, discussed, and agreed upon. This approach included three fundamental components: (1) identification of key task "drivers"; (2) development of an execution plan for the surveys; and, (3) implementation of the plan and other associated task efforts.

2.1 TASK DRIVERS

For any task, certain key factors, or drivers, dominate how the task is performed. Early recognition and identification of these factors assist greatly in formulating a reasonable strategy to accomplish the task. For this survey effort, the Survey Team responded to the following task drivers:

- Scope of the Survey Task
- Scope of the Services' Modeling and Simulation Efforts
- Critical Environmental Factors for Military Models and Simulations
- Value to the Warfighter
- Time and Funding Constraints

These factors will be discussed in the five subsections that follow.

2.2.1 Scope of the Survey Task

The scope of the survey task has been introduced in Section 1.3. To summarize that section, the Requirements Survey effort is focused on the Military Services' requirements for incorporating the atmosphere and near space environment into the M&S activities, whether stand-alone or distributed activities.

One issue that the Survey Team raised while scoping the task effort was the definition of the terms "atmosphere" and "near space environment," inasmuch as the Team focused on these domains of the natural environment. Although meteorologists and space scientists have elegantly defined these regions of the earth's natural environment primarily in terms of the physical constituents and processes that dominate each region, the Survey Team became convinced that the military modeling and simulation community should have a simpler set of definitions to help in understanding the Survey Task's concepts and technical questions. Definitions proposed by the Distributed Interactive Simulation (DIS) community were identified as acceptable candidates. After several discussions, the following definitions were agreed upon:

- Near space environment: 300-km to 70,000-km (approximately 11 earth radii) altitude
- Atmosphere: 1-km to 300-km altitude
- Near-earth atmosphere: Land-ocean surface to 1-km altitude

2.2.2 Scope of the Military Services' Modeling and Simulation Efforts

The second key driver for the Survey Task was the perceived scope of the Military Services' M&S user community and the Military Services' environmental database and modeling community. Intuitively, all Survey Team members perceived the scope of the Services' modeling and simulation as being large, both in terms of the number of organizations involved in each Service and the number of warfighting-related models that existed in each Service. This commonly-held perception assisted the Survey Team in deciding upon a "top-down" approach, as opposed to a "bottom-up" approach, for developing and executing its tasking. The top-down approach essentially meant that the Team would initially coordinate any survey plan with each of the four Services' principal point-of-contact for modeling and simulation at the highest organizational level in that particular Service. The bottom-up approach, on the other hand, meant that the Survey Team would pursue numerous points-of-contact within the Services' M&S community.

Although the actual numbers of models and simulations in each Service were not known initially, the Survey Team's perception that the numbers were large, perhaps as many as 1000, mandated that some discriminating way had to be used to select the major, or primary, modeling and simulation activities underway in each of the Services. The top-down approach appeared to provide the higher probability for success in early identification of the Services' major M&S efforts than the bottom-up approach.

Based on the collective experience of the Survey Team, it was anticipated that, regardless of what approach was taken, there would be difficulty in obtaining responses from the Services' M&S community because of the many technical questions being asked in the Requirements Survey. The top-down approach, however, would make the Services' headquarters staff members aware of the survey and inform them of the intent of the survey well before their subordinate organizations were requested to expend personnel resources in responding to any survey questions. The Survey Team felt that this was an important advantage. In case difficulties were encountered in obtaining responses to survey questions, the Team would have access to Service headquarters' points-of-contact who were familiar with the survey and who might render assistance in obtaining the necessary responses. Although the top-down approach would equate to more time being

spent initially coordinating the survey effort with the Services headquarters staff, the Survey Team's government representatives accepted the scheduled risk in view of the benefits associated with this approach.

2.2.3 Critical Environmental Factors for Military Models and Simulations

The essence of the entire survey effort centers around identifying and defining the Services' requirements for incorporating the natural environment—the atmosphere and near space environment—in their modeling and simulation activities, that is, determining the critical environmental factors for each model and simulation. This key task driver dominates the survey effort and is reflected in the number of questions posed to the military M&S community to capture an understanding of its requirements for incorporating the natural environment. Section 2.3 contains an indepth discussion of these questions used in the questionnaire that was developed to support the survey effort.

2.2.4 Value to the Warfighter

One of the other key drivers is the value to the warfighter. Warfighters are the ultimate customers for all the Services' modeling and simulation activities, either directly or indirectly, individually or collectively. Their operational experiences in the real-world's natural environment provide them with first-hand familiarity of the effects the natural environment can play on their own forces, platforms, weapon systems, sensors, and communication systems, and those of the enemy as well. **For a simulation to be realistic, hence, valuable, in the eyes of a warfighter, the effects of the natural environment should be properly taken into account.** The structure of the Survey Questionnaire attempts to use terms familiar to warfighters, as well as terms familiar to the military modeling and simulation community.

2.2.5 Time and Funding Constraints

Two significant drivers for most tasks are time and funding constraints. The E^2DIS Project's Survey Task was limited to 2 years. Funding constraints limited the amount of personnel resources assigned. These two constraints combined, consequently, to limit the number of modeling and simulation efforts pursued.

2.3 EXECUTION PLAN DEVELOPMENT

Given the key task drivers, the Survey Team developed a plan to execute its top-down strategy. This plan includes the following major components:

- Soliciting support from the DMSO and key service points-of-contact
- Developing and testing the Requirements Questionnaire
- Drafting and coordinating letters of intent

- Conducting the survey using questionnaires, and telephone and personal interviews with M&S technical experts
- Designing and managing a database
- Analyzing the data from returned questionnaires
- Reporting the results of the analysis

These components are discussed in the subsections that follow.

2.3.1 DMSO and Service Support

Liaison visits, meetings, and briefings were conducted early in the Survey Task's schedule to obtain support in principle from the DMSO and the Services. Consistent with the top-down approach, the first such visit was made to the DMSO representative for the E^{2}DIS Project in August 1993. The DMSO representative provided the Survey Team with an overview of the DMSO's background, mission, goal, and objectives. This visit indicated that the DMSO was fully supportive of the E^{2}DIS Project in general and the Survey Task effort in particular. From that meeting, however, a significant management issue was identified—**no master listing of major modeling and simulation activities was readily available to the DMSO.** The Survey Team had to seek such a list from each of the Services.

Visits and meetings with the Army, Navy, Marine Corps, and Air Force staffs' points-of-contact were subsequently conducted. All four Services were briefed on the E^{2}DIS Project and the project's survey task effort. They unanimously agreed to the intentions of the survey and affirmed their support for future coordination efforts associated with the Survey Task. The same management issue identified during the earlier visit with the DMSO representative was mentioned by all four Service representatives. Although various listings of models and simulations existed within each of the Services, **none of the Services had a single, consolidated listing of their major modeling and simulation efforts.**

2.3.2 Requirements Questionnaire

Based on the collective experience of the Survey Team members, a questionnaire for the Requirements Survey was developed. The following subsections describe not only this development but also the testing of the Requirements Questionnaire.

2.3.2.1 Development

In parallel with soliciting and garnering support from the DMSO and the four Services, development of questionnaires for both the Requirements and Capabilities Surveys began. Since the results of both surveys (i.e., the responses from both the Requirements and Capabilities Questionnaires) would eventually be compared and assessed, the E^2DIS Project's Survey Team decided to structure the questionnaires as similarly as possible. Both questionnaires were divided into two parts: administrative information and technical information. An example of the Requirements Questionnaire is presented in Appendix A.

The administrative information section of the Requirements Questionnaire requests information on such items as the simulation or model title, a brief general description of the simulation or model, and the identity of a technical expert for the simulation or model, as well as the principal service owner. This type of information would be critical in attempting to perform quality control, or followup work, on the responses to various questions.

The technical information section of the questionnaires is the essence of the survey. It has seven subsections and three attachments. The seven subsections are

- Critical Environmental Factors
- Status of the Simulation or Model
- Application of the Simulation or Model
- Domain of the Simulation or Model
- Current Requirements
- Future Requirements
- Environmental Capabilities Briefing

Using the top-down approach, the Survey Team decided to develop some of the application questions based on the modeling and simulation technical structure established by the DMSO in conjunction with the Services and the other DoD component organizations. That is, the Survey Team sought to construct a framework for the questionnaires that would be relevant and understandable to the DMSO and the Services' modeling and simulation community.

(1) **Critical Environmental Factors.** The Survey Team felt that it was important for the respondents to highlight early in the questionnaire what the critical factors, if any, are for the model or simulation regarding the atmosphere and near space environment. It also

provided the technical expert for the model or simulation with an opportunity to respond in qualitative terms to what the key atmospheric and near-space-environment issues are without going into the detailed quantitative responses required later in the questionnaire. The Survey Team also felt that responses for this subsection could be used to assist in quality controlling the questionnaire's more detailed answers.

(2) **Status of the Simulation or Model.** Only a few basic questions are asked concerning the status of the model or simulation. The Survey Team wants to know: Is the model or simulation being used today? If so, how often? If it is not being used today, when will it be used?

(3) **Application of the Simulation or Model.** This is often a key reference point. Several questions are asked about the application of the simulation or model in terms of its use in DIS, the type of simulation it is used for, its functional use, its hierarchical category, the types of applications supported, its military contents, and its documentation. In this subsection the DMSO technical structure is explicitly integrated. Specifically, the Survey Team uses the three "types" of simulations (i.e., live, virtual, and constructive) in one of the first few questions and uses the five "functional areas" (i.e., Research and Development; Test and Evaluation; Analysis; Production and Logistics; and Military Operations, Education, and Training) (Under Secretary of Defense for Acquisition and Technology, 1995) in the next question.

Regarding the hierarchy of models and simulations, during an early liaison visit with an Air Force representative, an important point was made by the representative. *De facto* in the Air Force, models and simulations were being categorized according to the scheme shown in Figure 1.

This scheme however raised another corollary issue: If the Air Force had such a hierarchy, do the other Services have a modeling and simulation hierarchy? After several visits and conversations with representatives from the Army, Navy, and Marine Corps, it was determined that of these three branches only the Army had an established M&S hierarchy. It is shown in Figure 2.

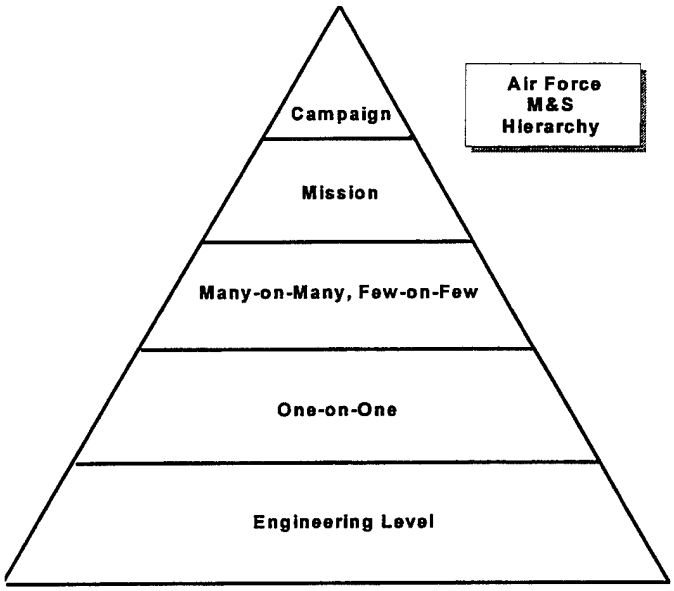


Figure 1. Air Force hierarchy of models and simulations.

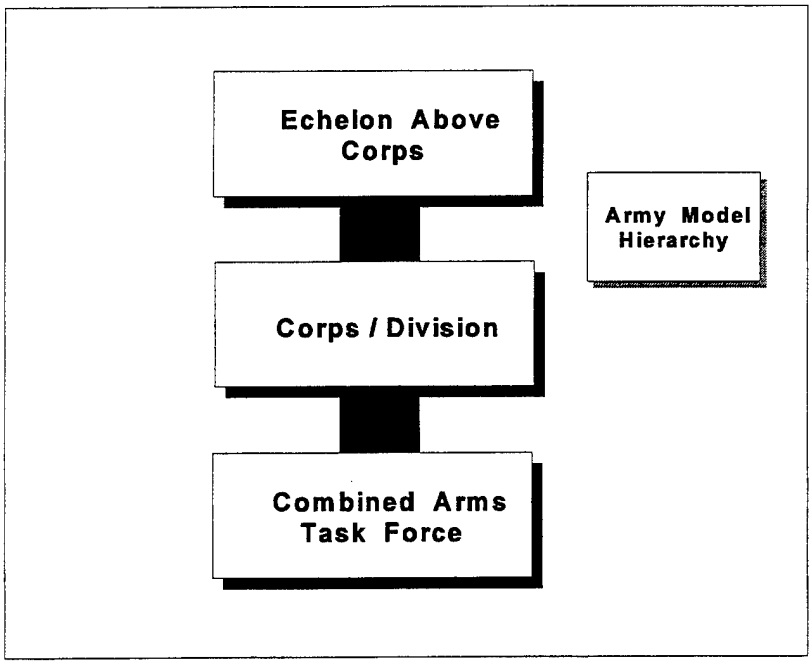


Figure 2. Army hierarchy of models and simulations.

As shown in Figures 1 and 2 the Air Force's hierarchy is platform and weapon-system oriented, while the Army's hierarchy is force and personnel oriented. A question was developed for the Requirements Questionnaire that incorporated both hierarchies.

Questions related to specific military aspects of the model or simulation are also posed in the Applications subsection. A question on the types of applications supported, such as sensor acquisition of targets and mobility of forces and platforms, is also posed. In addition, order-of-battle information is requested in general terms to help in understanding the complexity and use of the model or simulation.

The final question in the Applications subsection requests identification of the most authoritative source document for the model or simulation. This question is included in the event the Survey Team needs to follow up with additional detailed questions that the technical expert might not be available to answer.

(4) **Domain of the Simulation or Model**. The Survey Team categorizes the simulation or model's domain in terms of the space (horizontal surface and vertical) dimensions and time dimension. Again, this information is needed to help the Survey Team understand the complexity and use of the model or simulation. Questions for the horizontal and vertical domain include references to the ocean environment. This information is included to assist the MEL Project team members in their complementary survey effort of ocean requirements for military models and simulations.

(5) **Current Requirements**. Given the preceding questions, which are relatively general in nature, this subsection focuses on detailed quantitative questions about the model or simulation's current requirements for atmospheric data and effects and near-space-environment data and effects. Three attachments provide these detailed questions. The first attachment focuses on the atmosphere. The second attachment contains similar questions for the near space environment. The third attachment seeks information on other technical areas, such as verification, validation, and accreditation requirements. Answers to these detailed requirements-oriented questions are necessary for the Survey Team to compare with answers resulting from the Capabilities Survey questionnaires.

(6) **Future Requirements.** A few questions are asked in this subsection of the Requirements Questionnaire to determine if the model or simulation is planned for an upgrade. If so, whether the upgrade might change the current requirements for atmospheric or near-space-environment data; if not, whether an upgrade should be considered if environmental data and environmental effects data could be reliably provided. An implicit assumption for this latter question is that, perhaps, the unreliability of receiving environmental data, regardless of type, may inhibit any potential upgrade.

(7) **Environmental Capabilities Briefing.** The Survey Team considered the possibility that the Requirements Questionnaire respondents might not be familiar with the Services' environmental science community and its capabilities. It was decided that a question be included in the Requirements Questionnaire that asked for the respondents to indicate an interest in receiving a briefing on atmospheric and near space parameters, and feature processes and effects that relate to the relevant M&S effort.

2.3.2.2 Beta test

Before distributing the Requirements Questionnaire to the many different organizations in the services, the Survey Team conducted a beta test on the questionnaire. Representatives from the Navy's Naval Air Systems Command volunteered to perform this test. Several substantive comments and recommendations were received and integrated into the questionnaire to improve its quality. Appendix A contains the final version of the Requirements Questionnaire used in the survey.

2.3.3 Letters of Intent

To implement the survey, the Survey Team drafted a letter that described the overall intent of the Requirements Survey, requested a listing of the major modeling and simulation efforts underway, and provided a copy of the Requirements Questionnaire for information. The draft letter only requested that the responding organization list the major modeling and simulation efforts and identify a technical expert for each effort. Completion of the questionnaire was not initially requested. The draft letter did indicate that completion of the questionnaire would proceed at a later date, once the list of major models and simulations was received. The Survey Team proposed this two-step approach because no such list existed in any of the Services and it was felt that the list was essential to scoping and focusing the survey effort.

Taking the top-down approach, the Survey Team personnel coordinated the draft letter with the DMSO for signature, release, and distribution to the Services. After considering the contents and intent of the draft letter, the DMSO recommended that it be coordinated and released by the individual services. During this staffing process, the DMSO provided some comments and recommendations that further improved the letter's focus and content. Coordination with each of the four Services ensued.

The Survey Team coordinated meetings and briefings to discuss the intent of the draft letter with each of the Services primary point-of-contact for modeling and simulation. The Army was the first service to release a letter to its organizations. The Air Force, the Marine Corps, and the Navy followed within a few months either to release formal letters or to solicit the requested information informally. It should be noted that only the Army took the two-step approach. The Air Force, the Marine Corps, and the Navy opted to have their organizations directly provide completed questionnaires to the Survey Team. Copies of the Army, Air Force, and Navy correspondence are contained in Appendix B.

2.3.4 Interviews

The Survey Team perceived the interview process with the technical experts for models and simulations as mandatory to ensure that the requirements questionnaires were completed with technically accurate responses. The general experiences of the Survey Team's individual members with non-environmental science communities indicated that even the most general concepts and definitions of terms used by atmospheric and space scientists were often not understood, or misunderstood, by communities other than their own. Although personal interviews were the preferred option, time and funding constraints dictated that telephonic and electronic interviews also had to be used to ensure timely completion of the survey effort.

2.3.5 Requirements Database

The Survey Team selected the commercial, off-the-shelf *PARADOX for Windows* software database management system for both the requirements and capabilities survey sets of data to provide an efficient, structured method to organize, archive, retrieve, analyze, and display data.

2.3.5.1 Database Design

Using the capabilities of the *PARADOX for Windows* software program, the Survey Team designed the Requirements Survey database to accomplish two important goals:

(1) Provide a standard methodology by which the large amount of surveyed information could be managed.

(2) Assure that the database could be easily understood by anyone familiar with relational databases and be relatively easy to use by someone who was not completely familiar with relational databases.

With these two goals in mind, The Survey Team designed the database such that the Requirements Questionnaire is associated with 23 database tables. All 23 database tables correspond directly to questions in the Requirements Questionnaire.

Each database table contains relational information and a common field that allows the tables to be linked together. Typically, this linkage is accomplished by using a "model or simulation tracking number," which is an arbitrary, but unique, number assigned to each questionnaire received. Each record (row), or group of records, in a table corresponds to a specific questionnaire; each field (column) corresponds to a specific questionnaire entry. The model or simulation tracking number is used in most of the database tables as the initial field entry.

In keeping with sound relational database development theory and practice, the database tables are small in terms of the number of fields. No table has more than 18 fields, and most tables have 10 or less. The database tables, their relationship to the Requirements Questionnaire, and the contents of each field in a table are described in detail in Appendix C.

2.3.5.2 Database Management

The Requirements Survey has accumulated a formidable amount of data from the 74 questionnaires. The Survey Team personnel have archived the data by manually entering the data from each of the requirements questionnaires received into the appropriate database tables. To minimize opening and closing tables and to allow checking of similar data for inconsistency or input error, the same portion of several questionnaires was entered into the appropriate database table simultaneously. After sufficient data were entered into these tables, retrieval and analysis of the data could begin.

The database management system has the capability, called Query By Example (QBE), to pose questions (or queries) about data, explore data in the database, and obtain answers quickly. A query can be

a simple question of a single table, or a complex question involving several tables. The QBE provided a powerful means to extract pertinent information from a large amount of data that otherwise would have been difficult to analyze. The results of queries, called "answer tables," were used as basic input for the Survey Team's analysis reported in Section 3. In addition, database management system "reports" that summarize and display relational information were generated and used by the Survey Team to analyze the acquired data.

One example of a database management system report that the Survey Team used is "MODELIST.RSL." It is a report that sorts the models and simulations in the database first by service, then alphabetically by model or simulation title. Also included in the report is the description of the model or simulation, as well as the critical environmental factors or issues that pertain. A complete listing of all the database management system reports used by the Survey Team is given in Appendix D.

The database, consisting of *PARADOX for Windows* tables, queries and several reports, is available on a 3.5" floppy diskette from the Phillips Laboratory/Geophysics Directorate Atmospheric Structures Branch (PL/GPAA), 29 Randolph Road, Hanscom Air Force Base, Massachusetts 01731-3010.

2.3.6 Analysis of Data

Reliance on the QBE capabilities of the *PARADOX for Windows* software program was fundamental in planning for the quantitative analysis of the Requirements Survey technical data. By simply querying the Requirements Survey database, retrieval and analysis of the responses to each question from the technical section of the Requirements Questionnaire was planned.

For every question having prescribed multiple choices for answers, sorted sets of answers would be retrieved. That is, all questionnaires responding with the same answer choice to a given question would be grouped, or sorted, into a set; the number of sorted sets, therefore, would correspond to the number of possible answer choices for that given question. The use of soft-copy answer tables and paper-copy tabular reports, was planned for the initial analysis of these basic, sorted answer sets. Graphical display and additional analysis of these same basic answer sets were also planned for the report writing phase. Using *Word Perfect Draw 3.0* as the software graphics program, answer sets for each question would be displayed in soft copy and analyzed.

Not all the questions had multiple choice answers, however. For those questions that had free-formatted, fill-in-the-blank type answers, each response was planned for review and comparison with answers for the same question in the other questionnaires. Again, the QBE capability would be used to query the database for these types of answers. Where similar answers were being provided, the Survey Team would plan to sort those into arbitrary groups for use in further analysis and final reporting.

To determine whether there might be relationships among responses to one question versus responses to another question, second-generation answer tables and reports could, and would, be constructed. Again, the QBE capability would be used when necessary.

2.3.7 Report of Results

The final major step in developing the survey plan was to report the results of analyzing the Requirements Survey data. This document was developed to record such results, including responses to all questions from the technical section of the Requirements Questionnaire. It was organized in a typical technical report format and was planned as the first document of a three-document set, as mentioned in Section 1. Accordingly, the results of the Requirements Survey reported herein were not necessarily intended to stand alone. They were planned to be used in conjunction with the results of the complementary E^2DIS Project Capabilities Survey to contribute to the understanding of some technical aspects of both the Military Services' M&S and environmental science communities. Nonetheless, the Survey Team speculated that the report might need to stand alone; consequently, this document would be written to provide that option.

2.4 IMPLEMENTATION

With the signing, release, and distribution of the first service letter, the Army's letter of 31 May 1994, officially announcing the intent of the survey effort within the Army, the Requirements Survey implementation phase began. Nonetheless, simultaneous with this implementation, the Survey Team continued to coordinate with the other Services until all the Services had announced the E^2DIS Project Requirements Survey, either via formal letters or informal memoranda. See Appendix B for correspondence from the Army, Air Force, and Navy regarding these announcements. The Air Force and the Marine Corps made distributions within their respective services. The Survey Team distributed the letters from the Army and the Navy to all the organizations indicated on the appropriate Service's distribution list. Included in the Navy's distribution was a Coast Guard organization that provided a completed questionnaire on a model used in search and rescue planning. In addition, the Navy submitted a questionnaire that identified and described

a Coast Guard flight simulator. Both of these questionnaires are included in the Survey Team's database under the Coast Guard category.

Because each Service took a different course of action in announcing the survey effort and soliciting responses, the overall response from each of the Services has been mixed. A summary of the responses is shown in Table 1. Appendix E provides a list of the 208 M&S efforts that were considered. The 74 respondents to questions are listed at the end of this section.

As described in Section 2.3.3, the Army organizations were the first requested to provide the Survey Team with a list of their major modeling and simulation efforts, and later to provide completed questionnaires. The Army response to the first part of the tasking was excellent, both in quantity and timeliness. More than 100 models and simulations were identified as being "major" from the perspective of the organization responding to the Army letter. Most respondents provided their list within 30–60 days of receiving the Army letter.

Table 1. Requirements Survey Results

Service / Agency	Requirements Survey Results			
	No. of Organizations Polled	No. of Organizations Responding	No. of Major M&S Efforts	No. of Questionnaires Completed
Army	98	40	107	17
Navy	28	16	51	28
Marine Corps	5	5	8	5
Air Force	37	17	39	21
Advance Research Project Agency	2	1	1	1
Coast Guard	0	1	2	2
Totals	170	80	208	74

Also as described in Section 2.3.3, the Air Force, the Marine Corps, and the Navy requested that their organizations only complete the questionnaire; they did not ask for lists of major models and simulations from their subordinate organizations. Consequently, completed questionnaires have become the basis for a list of major models and simulations for each of these three Services. The Survey Team has coordinated with points-of-contact in the principal Air Force, Marine Corps, and Navy modeling and simulation management offices to verify subjectively the relative merit of this *de facto* list of "major" modeling and simulation efforts. The result from this coordination process has been to continue to include all the models and simulations for which questionnaires on the Service's list have been completed and therefore are in the database.

The Survey Team made a concerted effort to ensure that the quality of the returned requirements questionnaires was adequate in terms of applicability and detail. This two-pronged quality control effort meant that each questionnaire was reviewed for general applicability to the Requirements Survey and, if passing that test, reviewed in detail for completeness. As a result of the first step in the quality control effort, two requirements questionnaires from the Air Force, both related to modeling the near space environment, were determined to be more appropriate for the Capabilities Survey. Data from both of these questionnaires have been entered into the Capabilities Survey database and will be included in the Survey Team's report on the Capabilities Survey. The remaining 74 requirements questionnaires were scrutinized for completeness and, when necessary, the Survey Team contacted the technical expert indicated on a questionnaire about missing answers to questions.

It is important to note that the Survey Team placed particular quality control emphasis on ensuring that answers to questions related to atmospheric and near-space-environment data types, and associated time and space resolutions, were provided. These answers were crucial for the Team's overall task effort because they were the basis for comparing the environmental science community's modeling capabilities with the M&S community's requirements for the same atmospheric and near-space-environment data types (see Burgeson et al., 1996a and b).

The list of the Services' major modeling and simulation efforts prepared by the Survey Team to compile the results in this report is duplicated here. In Appendix F these entries are expanded to include a brief description of each model or simulation, along with the identified technical point-of-contact and the critical environmental factors.

Service or Agency	Models and Simulations in the Requirements Survey Database
A. Army:	1. Battlefield Environment Weapon System Simulation (BEWSS)
	2. Camouflage Multispectral Engineering Library and Analysis Station (CAMELIAN)
	3. Combined Arms and Support Task Force Evaluation Model (CASTFOREM)
	4. Communications-on-the-Move Radio Model (CMRM)
	5. Dynamic Ground Target Simulator (DGTS)
	6. Extended Air Defense Simulation (EADSIM)
	7. FOX Vehicle and CB/Smoke Atmospheric Models
	8. Integrated Unit Simulation System (IUSS)
	9. Logistics-Over-the-Shore Site Selection (LOSSS)
	10. Logistics-Over-the-Shore Throughput Planner (LOTSTP)
	11. Mounted Warfare Test Bed (MWTB)
	12. NATO Reference Mobility Model - II (NHRMM-II)
	13. Night on BDS/Paint-the-Night (NBDS/PN)
	14. SINCGARS Radio Model
	15. Terrain Evaluation Module (TEM)
	16. Transportation Infrastructure Assessment (TIA)
	17. Warfighter Simulation (WARSIM) 2000
B. Navy:	1. EGIS AN/SPY-1A/B/D Firm Track Simulation
	2. AEGIS Radar System Controller Environmental Simulation (RSCES)
	3. Chemical/Biological Agent Vapor, Liquid, and Solid Tracking (VLSTRACK)
	4. Combat System Engineering and Analysis System (CSEAL) Simulation System (CSS)
	5. Combat Systems Multi-Warfare Tactical Scenarios (CSMWTS)
	6. Composite Warfare Model (CWM) 3.4.0
	7. Cruise Missile Mission Planning and Weapon Control Systems: Tomahawk Land Attack Missile (TLAM)
	8. Enhanced Naval Warfare Gaming System (ENWS)
	9. Enhanced Naval Wargaming System (ENWGS)
	10. F-14D Training System
	11. Helmet-Mounted Mission Rehearsal Simulation System (HMMRSS)

12. Integrated Radar and Infrared Analysis and Modeling (IRIAM) System
13. Integrated Theater Engagement Model (ITEM)
14. Integrated Training Interface (ITI)
15. Manned Flight Simulator (MFS)
16. Mine Warfare Simulation Project
17. Naval Air Battle Evaluation Model (NABEM II)
18. Naval Simulation System (NSS)
19. Research, Evaluation, and Systems Analysis (RESA)
20. Space and Electronic Warfare Simulator (SEWSIM)
21. Target Acquisition (Targetacq)
22. Tactical Advanced Combat Direction and Electronic Warfare Environmental Generation and Control System (TACDEW EGCS)
23. Tactical Aircraft Mission Planning System (TAMPS)
24. TEMPER (APL), EREPS, IREPS, RPO, and DCS
25. Tomahawk Baseline Improvement Program (TBIP) Mission Planning Performance Prediction
26. Tomahawk 6DOF Flight Simulation Model
27. Tropospheric Propagation Model
28. Weapons Analysis Facility (WAF)

C. Marine Corps:

1. DFO/MULE
2. Environmental Effects on Sensors (EES)
3. MAGTF Tactical Warfare Simulator (MTWS)
4. Maneuver Warfare Analytical Research System (MWARS)
5. Team Target Engagement Simulator (TTES)

D. Air Force:

1. A/F 37A-T84 F-15 Weapon System Trainer
2. Advanced Electro-optical Model for Aerial Targeting (AE*MAT)
3. Air Force Command Exercise System (ACES)
4. Air Force Mission Support System (AFMSS)
5. Air Warfare Simulation (AWSIM)
6. BRAWLER
7. COMBAT IV

8. Contingency Theater Automated Planning System (CTAPS)
9. C^2W Analysis and Simulation System (C^2WASS)
10. Improved Many-on-Many (IMOM)
11. Joint Modeling and Simulation System (J-MASS) Project
12. Mission Environmental Requirements Integration Technology (MERIT)
13. Multiship Training Research Facility (MTRF)
14. National Air and Space (Warfare) Model (NASM)
15. Satellite Assessment Center (SATAC)
16. SOF Aircrew Training System (ATS)/SOF Training and Rehearsal System (TARP)
17. Space Surveillance Network Tracking Error (SSNTE) Model
18. SUPPRESSOR
19. Threat Engagement Model (TEAM)
20. THUNDER
21. Unit Training Device (UTD) for A-10, F-15, and F-16

E. Advance Research Project Agency:
1. Synthetic Theater of War (STOW)

D. Coast Guard:
1. Computer Assisted Search Planning (CASP)
2. HH-60J Flight Trainer

3. ANALYSIS

This section presents the approach taken to analyze the data acquired during the Requirements Survey, the approach selected for presenting the analyzed data, and the results derived from analyzing the data. These data and results represent the principal quantitative basis for the recommendation presented later in this document.

3.1 APPROACH

The technical analysis of any data set has to consider the preferences, biases, and viewpoints of the customer who is expected to use the results of the analysis. In the case of this survey effort, the Survey Task Team, based on the collective experience of its members, perceives two **communities of customers** that might be interested in the results of the Requirements and Capabilities Surveys:

- The modeling and simulation community in each of the Military Services
- The environmental modeling and database community in each of the Military Services

As mentioned in the introduction of this document, the Survey Task Team's perception prior to conducting this survey effort indicated that the two communities of customers had little interaction with each other. The current survey effort has generally corroborated that perception. The survey interviews, in particular, indicate that each customer community has lacked knowledge, in some cases fundamental knowledge, of the technical requirements and capabilities of the other customer community. Consequently, the Survey Task attempts to overcome this lack of knowledge by identifying a set of technical issues that both communities of customers might use to establish a common baseline for further discussion, interaction, and, perhaps, joint partnership. Such interaction might, in turn, lead to improving the realism of the Services' M&S efforts, as well as providing the Services' priorities for research and development of atmospheric and near-space-environment databases and models. To communicate these technical issues, the Survey Task Team has attempted to construct both the Requirements and Capabilities Questionnaires, the database, and the analysis framework in a manner understandable to both communities of customers.

Within each of these two communities of customers, the Survey Task Team perceives two **levels of management** that might have an interest in the survey results:

- The staff headquarters level where broad, aggregated information is used to make programmatic decisions.

- The individual project manager level where much more specific information is required for decisions.

Using its top-down approach, the Survey Task Team organized both questionnaires and associated databases such that analyses may be made from the perspective of a Service headquarters representative, as well as from the viewpoint of an individual project manager within that Service. Typically, the Service headquarters' M&S representative and the environmental modeling and database representative are interested in "big picture" programmatic issues. For example, a question from the modeling and simulation headquarters representative might be: "Which of my service's models require environmental data input?" Or, "What are the critical environmental factors or data types for my service's models?" On the other hand, the environmental modeling and database headquarters representative might ask "On what environmental data types should I focus my research to support the modeling and simulation community?"

At the individual project manager level, technical questions or issues are more narrowly focused. A modeling and simulation community's project manager might ask "What is available to satisfy my simulator's requirement for cloud data?" While the environmental modeling and database community's project manager might ask "Who in the modeling and simulation community needs any of the cloud data that I am archiving?"

The Survey Task Team's analysis, therefore, is an initial step in identifying technical issues. It seeks to begin the process of communicating technical issues to two diverse service communities for their consideration. Some initial results, findings, and recommendations are provided to assist in this communication process.

3.2 DATA PRESENTATION

For this requirements document, the display of data in Subsection 3.3 is generally organized according to the sequence of questions contained in the Requirements Questionnaire (Appendix A). The responses for each question in the Requirements Questionnaire from the entire set of 74 questionnaires in the database are displayed and analyzed below. The Survey Team took this approach to summarize the overall response to the Requirements Survey. Graphical and tabular presentations are provided to aid the reader in understanding the responses and, therefore, the requirements of the M&S community.

3.3 RESULTS

Substantial amounts of data have been received from 74 requirements questionnaires. The answers to these questionnaires have been verified with the technical points-of-contact to ensure the credibility of the database and, hence, the basis for the Survey Task Team's requirements analysis.

3.3.1 Functional Use and Hierarchy

The analysis begins with a table showing the number of responses to questions in the Requirements Questionnaire that inquire about the functional use and hierarchical categories associated with the model or simulation. Some returned questionnaires indicated more than one choice for either the DMSO functional area or hierarchical level categories, or both. Only the responses from each questionnaire that indicated the "predominant category" for both the DMSO functional area and hierarchical level categories have been counted. This count is shown in Table 2.

With the exception of the production and logistics category, a fairly even distribution of models and simulations across the DMSO functional areas has been received. Also, the distribution shows a concentration of responses from the middle of the M&S hierarchy (i.e., one-on-one through the Mission level).

Table 2. Models and Simulations Categorized by DMSO Functional Area and Hierarchical Level

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Development	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			4		2	3	9
Mission	4		3	2	3	4	16
Many-on-Many / Few-on-Few	3	2	6		8	3	22
1-on-1	1	8	4		1	6	20
Engineering	5		2				7
Totals	13	10	19	2	14	16	74

3.3.2 Critical Environmental Factors

Tables 3 and 4 display distributions of the models and simulations regarding critical environmental factors or issues. In Table 3 the number of models and simulations are shown; a total of 54 were identified by the returned questionnaires as having critical environmental factors. In Table 4 the number of models and simulations are shown; 20 **did not** have any critical environmental factors identified. **It is noteworthy that only 55 percent (5 of 9) of the Campaign-level models and simulations, only 53 percent (8 of 15) of the Military Operations models and simulations, and only 68 percent (13 of 19) of the Analysis models and simulations were identified as having critical environmental factors.** The statistics are somewhat perplexing since these are the models and simulations that warfighters, who are the ultimate customers for M&S efforts and who are reasonably familiar with real-world environmental factors, would be expected to use routinely. It appears that those Campaign-level, Military Operations, and Analysis models and simulations not indicating any critical environmental factors might benefit by having critical environmental factors identified and eventually incorporated.

Table 3. Number of Models and Simulations Having Critical Environmental Factors Identified

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			2		1	2	5
Mission	3		3	2	1	3	12
Many-on-Many / Few-on-Few	2	2	3		5	2	14
1-on-1	1	6	3		1	6	17
Engineering	4		2				6
Totals	10	8	13	2	8	13	54

Table 4. Number of Models and Simulations Not Having Critical Environmental Factors Identified

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			2		1	1	4
Mission	1				2	1	4
Many-on-Many / Few-on-Few	1		3		3	1	8
1-on-1		2	1				3
Engineering	1						1
Totals	3	2	6	0	6	3	20

3.3.3 Documentation

Two separate questions were asked about the documentation associated with the critical environmental factors and the model or simulation overall. The left vertical bar in Figure 3 indicates that 76 percent of the models (56 of 74) are documented. The center vertical bar indicates that 73 percent of the models (54 of 74) have critical environmental factors identified in their response to the questionnaire. This number is the same 54 shown in Table 3. The right vertical bar indicates that 63 percent of the models (34 of 54) have documentation for their critical environmental factors. This chart indicates, therefore, that while the majority of the models surveyed have documentation associated with them and most have critical environmental factors identified in response to the questionnaire, **source documentation of those critical environmental factors is lacking for a substantial number of them.**

3.3.4 Status of the Simulation or Modeling Effort

One of the first questions asked about the model or simulation effort was its status. Three choices were provided as possible answers: "Operational today;" "Will be operational by FY-97;" and, "Other." As shown in Figure 4, the results indicate that over 60 percent (46 of 74) of the models and simulations surveyed are operational today, increasing to over 90 percent (68 of 74) by FY-97.

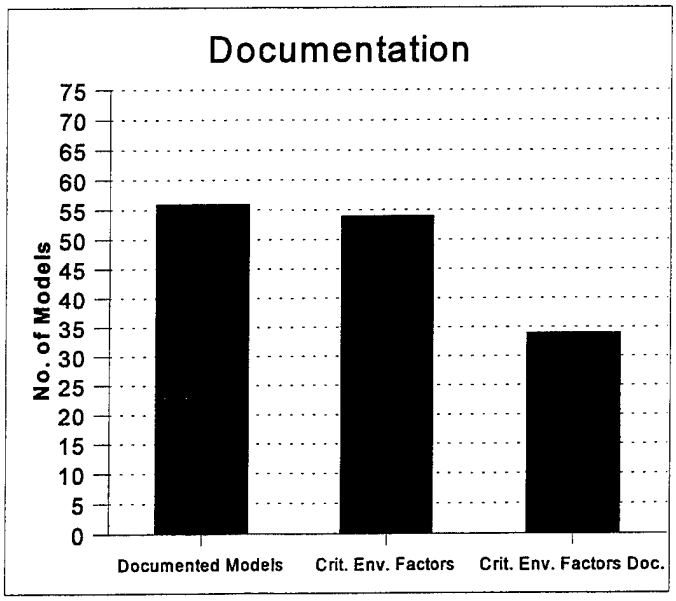


Figure 3. The number of models and simulations that have been documented, those that have critical environmental factors, and those that have documentation for the critical environmental factors.

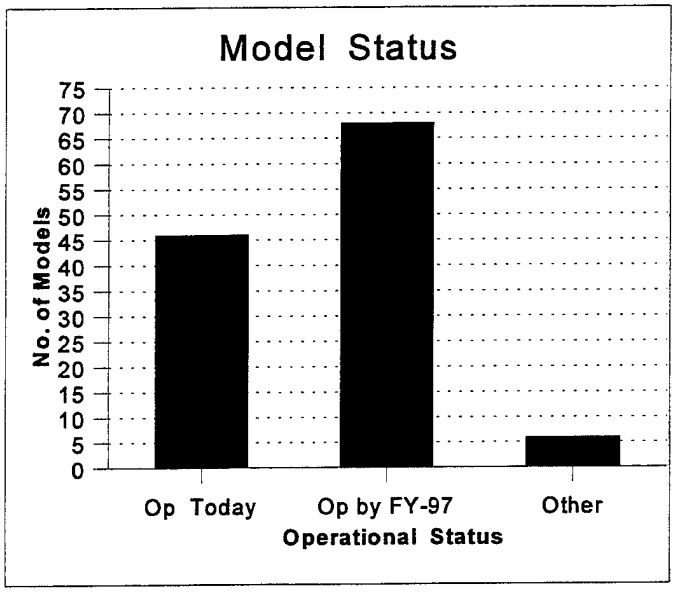


Figure 4. The number of models and simulations that are operational today, and the number that will be operational by FY-97.

3.3.5 Applications

Several questions are asked about aspects of the application of the model or simulation. The responses are summarized in the following subsections.

3.3.5.1 Use in distributed interactive simulation (DIS)

Figure 5 depicts the distribution of the surveyed models and simulations regarding their use in DIS. Note that about 19 percent (14 of 74) of the models are involved with DIS today, increasing to about 57 percent (42 of 74) by FY-97, but about 36 percent (27 of 74) have no plans to be involved with DIS.

3.3.5.2 Use in live, virtual, and constructive simulations

Of the 74 requirements questionnaires tabulated in the database as shown in Figure 6, 8 indicated a predominant use for live play, 41 for virtual simulations, 21 for constructive simulations, and 4 did not indicate a predominant use.

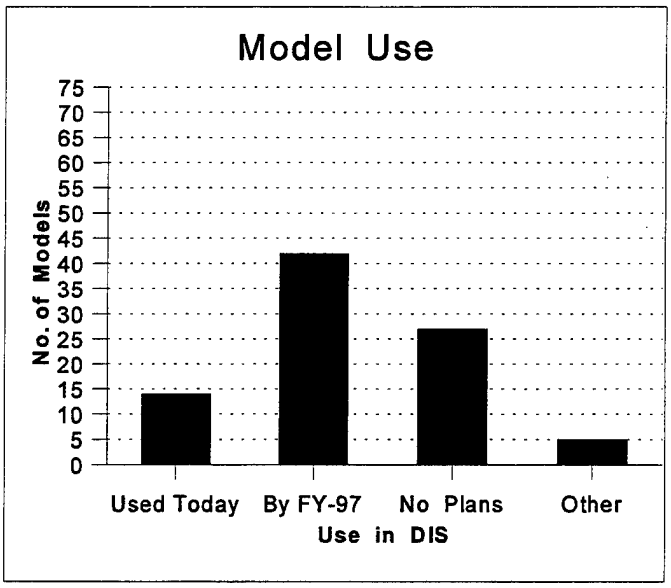


Figure 5. The number of models and simulations that are used in a Distributed Interactive Simulation (DIS) effort today, the number that will be used in a DIS effort by FY-97, and the number of models and simulations that are not planned for any DIS effort.

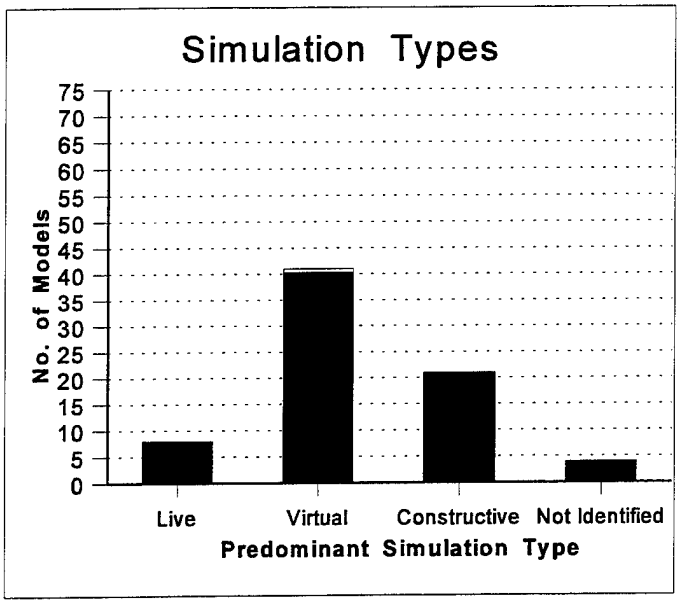


Figure 6. The number of models and simulations identified to be predominately either live, virtual, or constructive.

Shown in Tables 5, 6, and 7 is the distribution of the 70 models and simulations that indicated a predominant simulation type. Note that for live play, the dominant functional area tends to be Military Operations, while there is no dominating hierarchical level. For virtual simulations, three other functional areas (Research and Development; Test and Evaluation; and Analysis) dominate at the middle to lower levels of model hierarchy. Constructive simulations show some preference for the Analysis and Education and Training functional areas, while tending to be higher in the model hierarchy.

3.3.5.3 Types of applications supported

A question was asked about the types of applications supported by the model or simulation. The four choices for answers were "Sensor acquisition of targets;" "Mobility of platforms or forces;" "Decision aids for command and control authority;" and "Other." Respondents were permitted to choose more than one answer, besides indicating the predominant application. The response results are shown in Figure 7. Most of the respondents (64 of 74) indicated a predominant application for their model or simulation, with the decision aids category slightly larger than the sensor acquisition of targets. When considering both predominant and secondary applications, these choices were evenly split—a total of 51 each for sensor acquisition of targets and decision aids for command and control.

Table 5. Live Play Models and Simulations

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign					2		2
Mission					1		1
Many-on-Many / Few-on-Few					1	1	2
1-on-1			1		1		2
Engineering			1				1
Totals	0	0	2	0	5	1	8

Table 6. Virtual Models and Simulations

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			2				2
Mission	3				2	4	9
Many-on-Many / Few-on-Few	3		4		5	1	13
1-on-1	1	7	1			5	14
Engineering	2		1				3
Totals	9	7	8	0	7	10	41

Table 7. Constructive Models and Simulations

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			2			3	5
Mission	1		3	2			6
Many-on-Many / Few-on-Few		2	2		2	1	7
1-on-1		1				1	2
Engineering	1						1
Totals	2	3	7	2	2	5	21

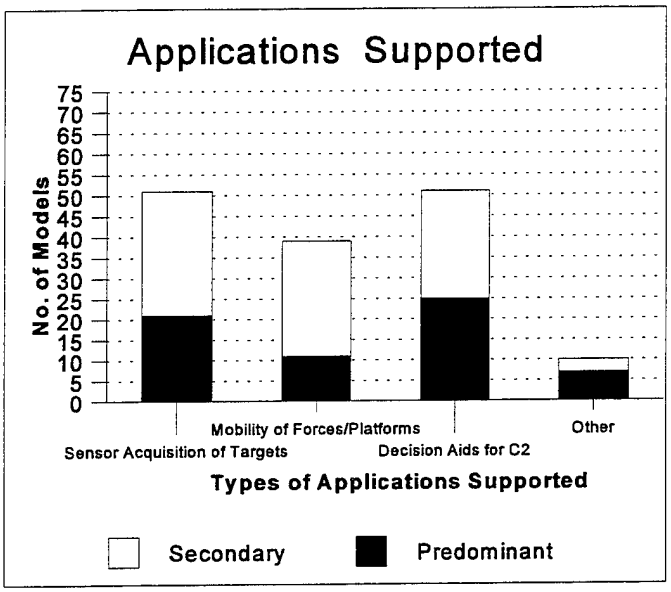


Figure 7. The number of models and simulations identified to have predominant and secondary types of applications.

3.3.5.4 Military object families modeled or simulated

The next question asked the respondents to identify missions, forces, platforms, weapon systems, communications systems, sensors, and targets being simulated or modeled. These seven military categories can also be termed "military object families." Figure 8 depicts the number of models and simulations incorporating each military object family. Missions were identified in 85 percent (or 63) and communications systems were identified in only 46 percent (or 34) of the returned questionnaires.

3.3.6 Domains

The next set of questions in the Requirements Questionnaire inquire about the model or simulation's domains—the horizontal surface, vertical, and the time domains. The following sections describe the results.

3.3.6.1 Horizontal surface domain

Nine possible answers were provided in the questionnaire for the respondents to choose. The respondents were requested to select as many as were applicable but to indicate the model or simulation's predominant horizontal domain as well. Figure 9 depicts the predominant domain and other applicable domains in the various models and simulations. The global, land-related, and littoral domains are predominant in this survey set. Those models and simulations with a predominant ocean-related or littoral domain have been identified for the MEL Project and its survey efforts. In the "None" column, note that eight questionnaires did not indicate a predominant domain; however, they did indicate several applicable horizontal domains. An implication from the "None" column is that the 30 models and simulations that did not identify other applicable horizontal domains have only one domain—their predominant domain.

3.3.6.2 Vertical domain

For the applicable and predominant vertical domains of the models and simulations, seven possible answers were provided as choices. Figure 10 depicts the response to those choices. Clearly, the atmosphere and the land surface dominate the survey dataset. Fifty percent (or 37) of the responses indicated that the atmosphere is the predominant vertical domain, whereas 22 percent (or 16) indicated that the land surface is predominant. A total of 90 percent (or 67) of the models and simulations apply to the atmosphere, whether it be predominant or otherwise.

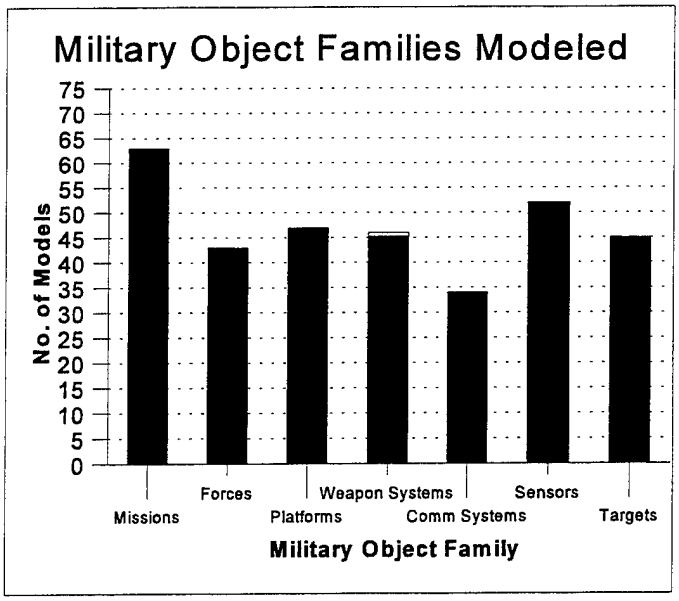


Figure 8. The number of models and simulations having military object families incorporated.

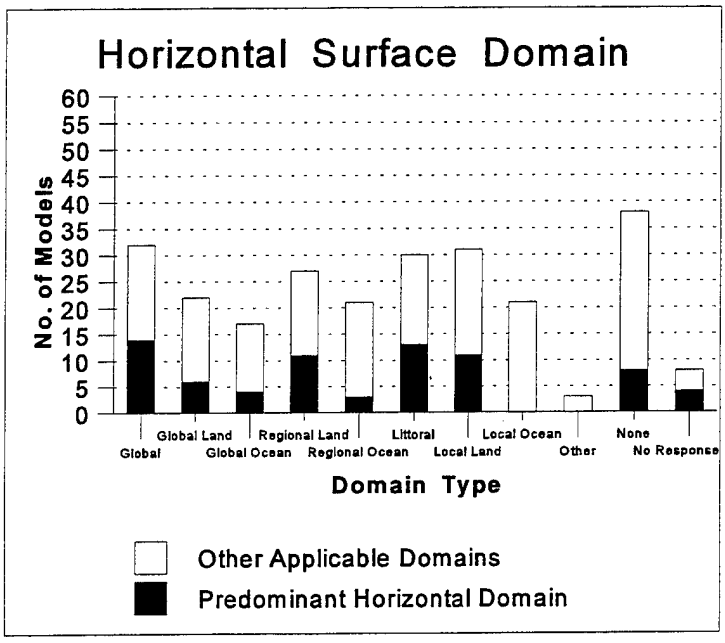


Figure 9. The number of models and simulations having predominant and other horizontal surface domains.

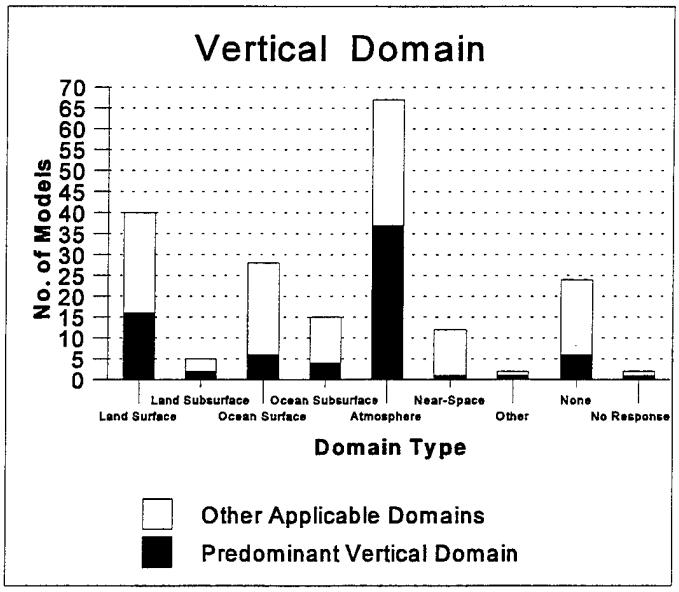


Figure 10. The number of models and simulations having predominant and other vertical domains.

The near space environment is predominantly represented in two models. Besides the one indicated in the "Near Space" column, the "Other" column's response refers to the ionosphere as being a predominant vertical domain. Also, note that 12 models and simulations apply to the near-space environment; 11 are shown in the "Near Space" column and one is shown in the "Other" column.

In the "None" column, six questionnaires did not indicate that the model or simulation in question has a **predominant** vertical domain. All six did, however, indicate that the model or simulation has more than one vertical domain type without any one being predominant.

3.3.6.3 Time domain

Respondents were also asked to provide information on their model or simulation's time domain, both in terms of the typical time period being simulated and the maximum time period that can be simulated. Figure 11 presents the results of the responses to this question. Note that most of the models in this survey, 78 percent (or 58), have typical time periods of minutes (i.e., less than an hour) to days (i.e, less than a week). Within this group, hours (i.e., less than a day) is clearly dominant. For the maximum time periods, hours, days, and months (i.e., less than a year) are generally most prevalent.

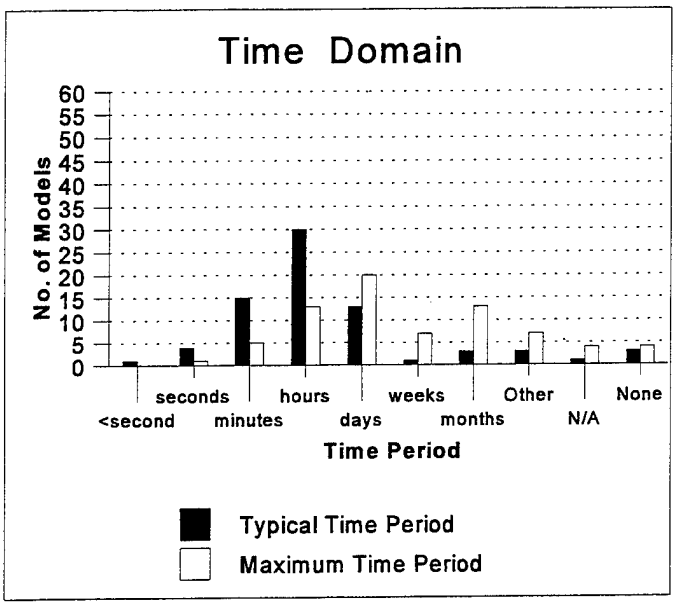


Figure 11. The number of models and simulations having "typical" and "maximum" time periods.

3.3.7 Current Requirements

Responses in this section refer to requirements that have to be satisfied today. Questions were asked about the grid used in the model or simulation, the types of environmental data and effects required, and other technical requirements.

3.3.7.1 Grids and map projections

A question was asked about the typical grid used by the model or simulation. Figure 12 depicts the results of the responses. Fifty-five percent of the models and simulations (or 41) used Cartesian, Defense Mapping Agency, or latitude-longitude types of grids.

A question was also asked about the typical map projection used. Figure 13 indicates that a majority of the models and simulations (38) either did not use a map projection or did not indicate what projection was used. Mercator projections were used by 22 percent of the models and simulations in the survey database.

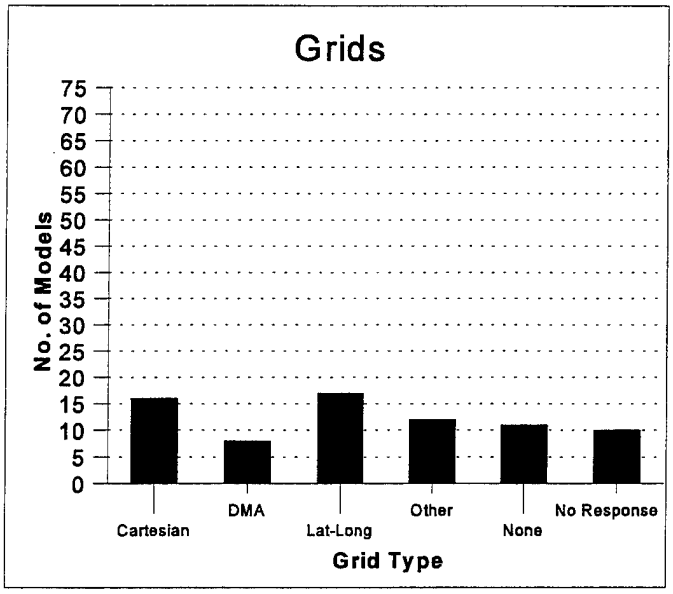


Figure 12. The number of models and simulations having various grid types incorporated.

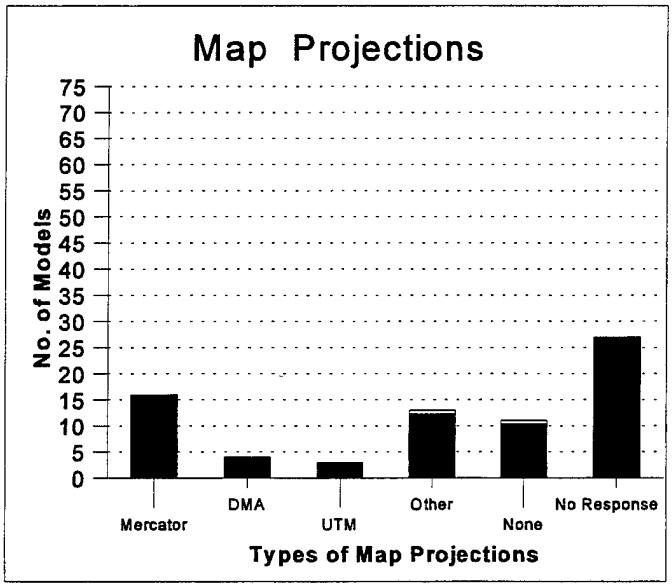


Figure 13. The number of models and simulations that incorporate various types of map projections.

3.3.7.2 Environmental data

The questionnaire listed 26 atmospheric data types and 23 near-space-environment data types for the respondents to select as requirements for their model or simulation. Respondents were requested to indicate whether their model or simulation **currently uses** these data types **or** has the **potential to use** the various data types. For those data types currently being used, respondents were also asked to indicate the fidelity requirements for each data type. Besides requirements for atmospheric and near-space-environment data, respondents were also asked to identify any other environmental data types or environmental effects (e.g., those associated with terrain or ocean) required for their model or simulation runs.

In the following subsections details are provided on the responses for (1) atmospheric data, (2) near-space-environment data, and (3) environmental data.

Atmospheric data requirements. The Requirements Questionnaire primarily focused on the **quantitative** aspects of the fidelity requirements. That is, questions were asked about the types of atmospheric data required and the spatial and temporal resolution requirements for each data type. The following paragraphs provide a description of the atmospheric data fidelity requirements for the models and simulations surveyed.

Figure 14 depicts the number of models and simulations surveyed that were identified to have current and potential requirements for any types of atmospheric data. **It is striking to see that 40 percent (or 30) of the models and simulations do not have current requirements for atmospheric data**. That is, 30 models do not incorporate any of the atmospheric data types listed in the next subsection. Yet, 17 of those 30 models have the potential to use atmospheric data. When these 17 are added to the models and simulations with current requirements, the net result is indicated by the dark-colored bar on the right-hand side of Figure 14, which depicts a total of 61 models and simulations with current and potential requirements.

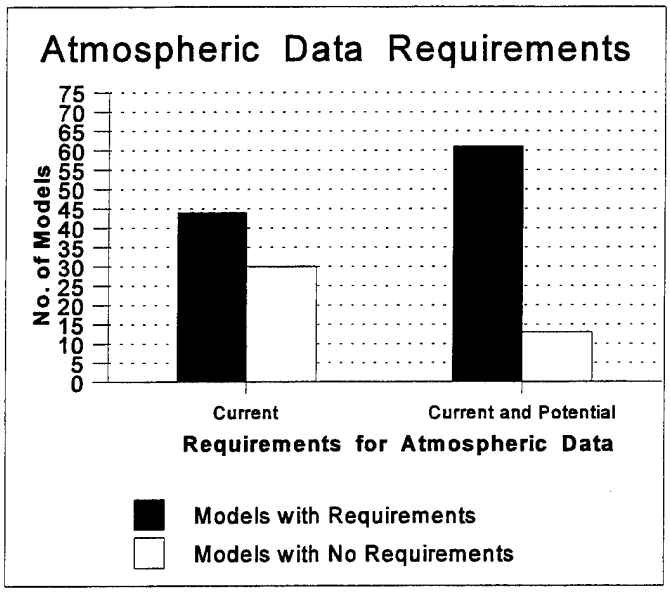


Figure 14. The number of models and simulations having current requirements for atmospheric data, and the number of models and simulations having both current and potential requirements for atmospheric data.

Atmospheric data types. Attachment 1 of the Requirements Questionnaire (see Appendix A) contains an expanded list of the 26 atmospheric data types, as well as questions on the fidelity and potential requirements for each data type. A summary list of the atmospheric data types is provided on the next page.

1. Aerosols
2. Atmospheric Electricity
3. Clouds
4. Dew Point
5. Fog
6. Humidity
7. Mixing Ratio
8. Precipitation
9. Refractivity
10. Sea Level Pressure
11. Static Stability
12. Temperature
13. Trace Gases
14. Transmissivity
15. Visibility
16. Wind
17. Wind Features (e.g., hurricanes)
18. Radiative Features (e.g., sky brightness)
19. Smoke
20. Chaff Dispersion
21. Combat-Generated Dust
22. Contrail Formation and Dispersion
23. Biological and Chemical Agent Dispersion
24. Nonnuclear Munitions Effects
25. Nuclear Detonation Effects
26. Ship Exhaust Tracks

As indicated in the preceding subsection, 44 of the 74 models and simulations in the database have current requirements for atmospheric data types. For these models and simulations, Figure 15 depicts the number of requirements for each atmospheric data type. **Note that data type 16, wind, has the most current requirements, a total of 33, which is 75 percent of those models having current requirements for any type of atmospheric data.** Clouds, data type 3, is second with 29 models and simulations having current requirements. Five other data types, 1, 5, 8, 12, and 15, corresponding to aerosols, fog, precipitation, temperature, and visibility, respectively, are currently required by approximately 25 of the models and simulations.

If the 17 additional models and simulations that have potential requirements for atmospheric data types are included and added to the current requirements, the same seven data types predominate as shown in Figure 15. **Note that wind, data type 16, remains dominant, while precipitation, data type 8, has the most potential requirements.**

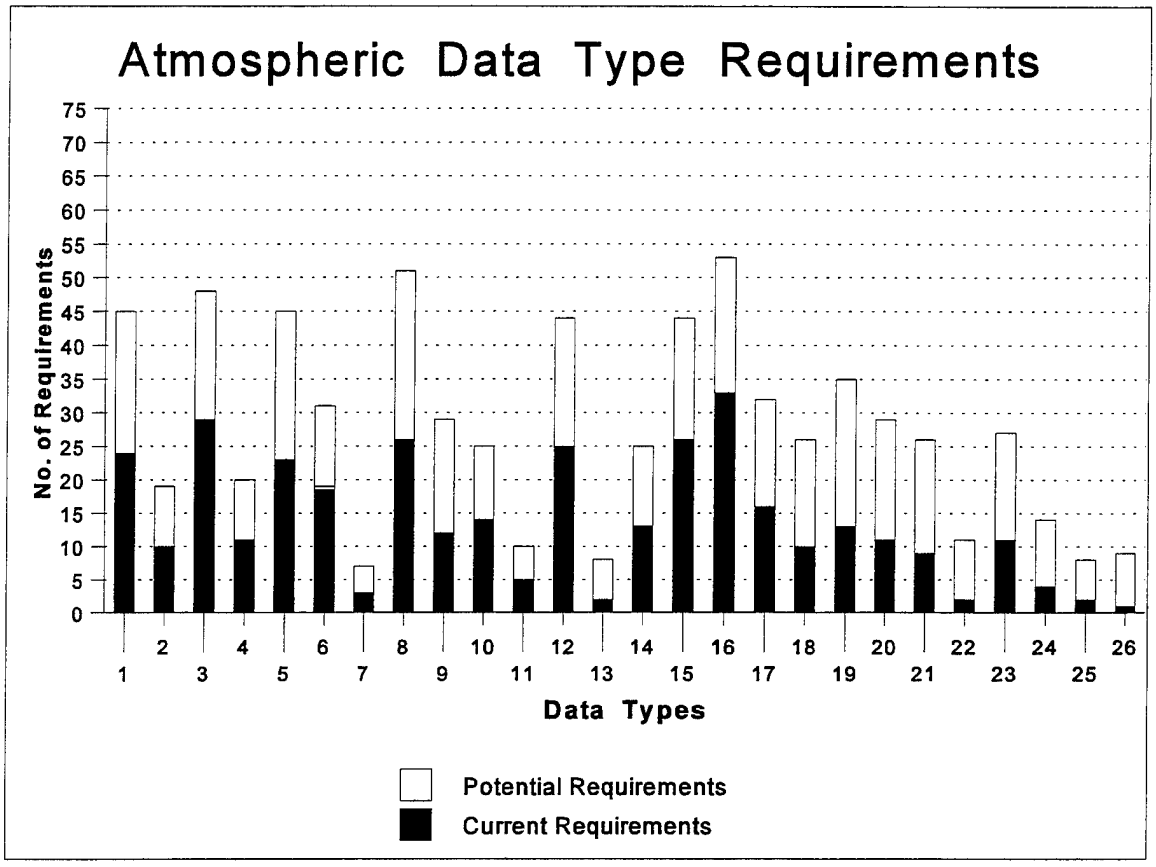


Figure 15. The number of requirements for each of the 26 atmospheric data types. Note that the number identifying each data type corresponds to that in the list of atmospheric data types on the preceding page.

Atmospheric data resolution requirements. Along with questions about the specific atmospheric data types required by each model or simulation, questions were also asked about the spatial and temporal resolution required for each data type. Figures 16–19 depict distributions of these resolution requirements.

As shown in Figure 14, the 44 models and simulations surveyed have current atmospheric data type requirements. Respondents have identified resolution requirements for 33 of the 44 models and simulations. For these 33 models and simulations with resolution requirements Figure 16 indicates that 29 models and simulations have horizontal resolution requirements, 22 have requirements for vertical resolution, and 31 have requirements for time resolution.

As shown in Figure 16, 8 of the 29 models with horizontal resolution requirements have more than one requirement. These 8 models provide 19 of the total 40 horizontal resolution requirements. The 40 resolution requirements shown in Figure 17 indicate a wide range and that requirements at 10 km and 100 m tend to dominate.

Based on Figure 16, 9 of the 22 models with vertical resolution requirements have more than one requirement. Vertical resolution requirements total 34 and are shown in Figure 18. These requirements also cover a wide range and those at 100 m and 1 km tend to dominate.

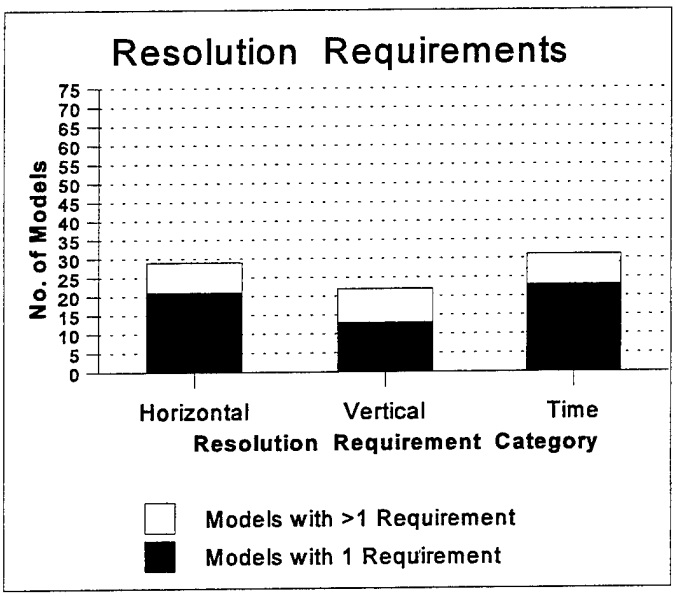


Figure 16. The number of models and simulations having resolution requirements for the horizontal, vertical, or time dimensions.

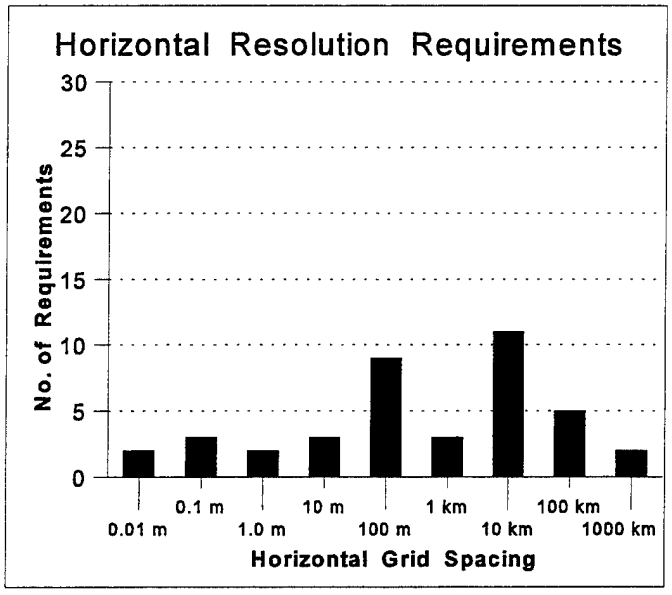


Figure 17. The number of horizontal resolution requirements for specific grid spacings.

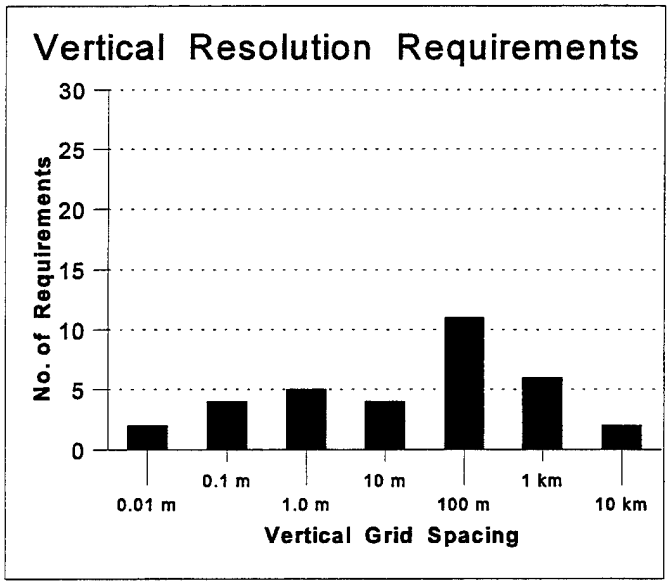


Figure 18. The number of vertical resolution requirements for specific grid spacings.

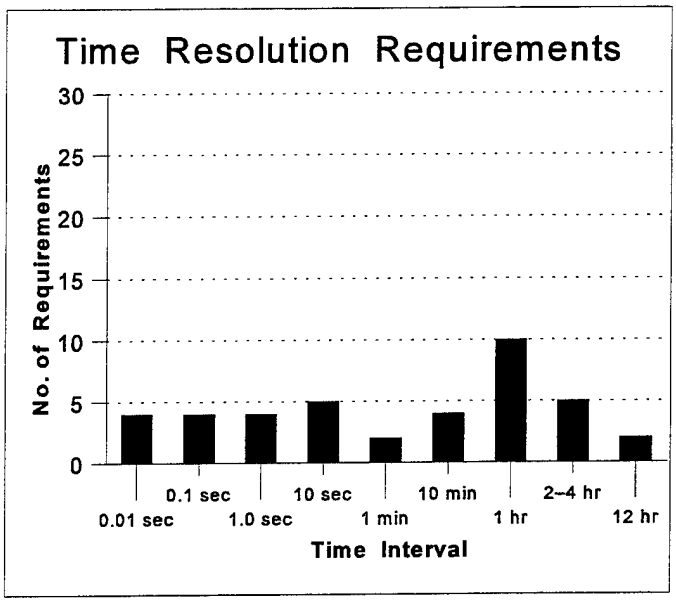


Figure 19. The number of time resolution requirements for specific time intervals.

As shown in Figure 16, 8 of the 31 models with time resolution requirements have more than one requirement. Time resolution requirements total 40 and are shown in Figure 19. Similar to horizontal and vertical resolution requirements, these requirements cover a wide range, but the interval one hour dominates.

Atmospheric effects requirements. Besides posing questions about requirements for atmospheric data types and resolution (see Appendix A), the Requirements Questionnaire also posed a series of questions regarding requirements for incorporating atmospheric effects in each model and simulation. This series of questions was expressed in terms of the atmospheric effects on military objects (i.e., forces, platforms, weapon systems, communications systems, and sensors), which are the same military objects identified in a previous question in the questionnaire and discussed briefly in Subsection 3.3.5.4. The responses from this earlier question provide a basic understanding of the types of military objects in each model or simulation. From the responses to the series of questions posed later in the questionnaire, the requirements for the atmospheric effects for each type of military object were given specific attention.

Figure 20 depicts the results of the responses to the series of questions on atmospheric effects requirements. For comparative purposes, Figure 20 also includes the results shown in Figure 8. Clearly, requirements for atmospheric effects on sensors dominate the set of models and simulations in this survey. But, **the most striking result is the almost complete lack of requirements for atmospheric effects on forces, platforms, and weapon systems. This unexpected result could be the focus of a detailed follow-up survey effort to determine why these three types of military objects are modeled without incorporating effects of the atmosphere.**

Near space data requirements. The following subsections describe the near space data fidelity requirements for the models and simulations surveyed. Similar to the atmospheric data portion, the Requirements Questionnaire primarily focused on the **quantitative** aspects of the fidelity requirements for the near space environment. Questions were posed about the types of near-space-environment data required and the spatial and temporal resolution requirements for each data type.

Figure 21 depicts the number of models and simulations surveyed that were identified to have current and potential requirements for any type of near-space-environment data. Seven models and simulations have current requirements, and three additional models and simulations have potential requirements.

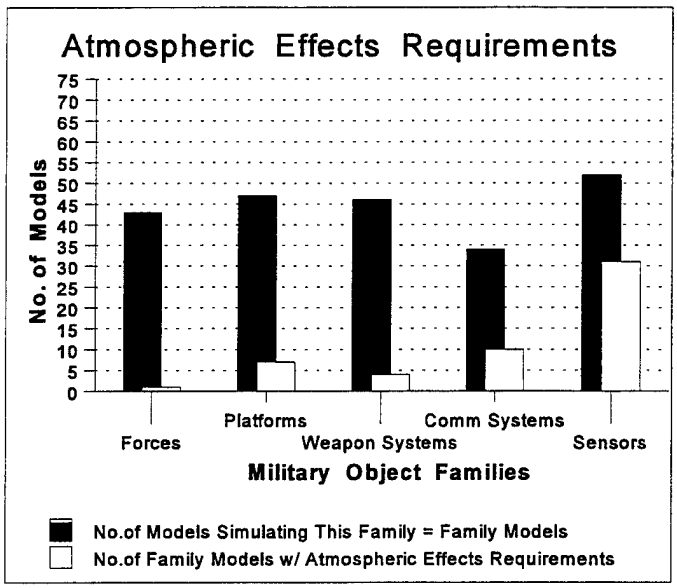


Figure 20. The number of models and simulations incorporating specific military object families and having atmospheric effects requirements for each military object family.

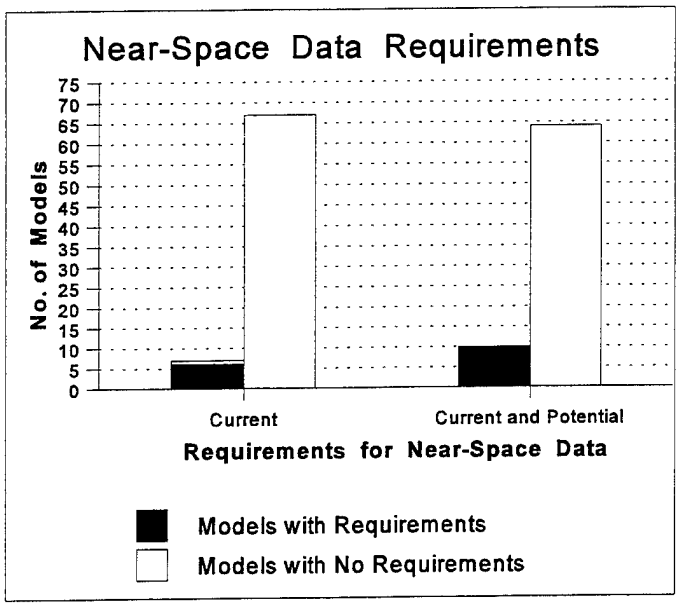


Figure 21. The number of models and simulations having current requirements for near-space-environment data, and the number of models and simulations having both current and potential requirements for near-space-environment data.

Near space data types. Attachment 2 of the Requirements Questionnaire (see Appendix A) contains an expanded list of the 23 near space data types, as well as questions on the fidelity and potential requirements for each data type. A summary list of the near-space-environment data types is provided below:

1. Auroral Particle Precipitation
2. Cosmic Rays
3. Diffuse Zodiacal Emission
4. Geomagnetic Field
5. Interplanetary Medium
6. Low Energy Plasma Environment
7. Lunar Parameters
8. Meteoroids and Debris
9. Neutral Environment
10. Radio Background Noise
11. Solar Parameters
12. Star and Planetary Position
13. Energetic Particles
14. Geomagnetic Storms
15. Gravity Waves
16. Noctilucent Clouds
17. Polar Cap Absorption
18. Sporadic E
19. Sudden Ionospheric Storms
20. Dispersal of Flares
21. Formation and Dispersal of Rocket Exhaust
22. Munitions Effects (Nonnuclear)
23. Nuclear Weapons Detonation Effects

For the seven models and simulations surveyed that have current requirements for atmospheric data types, Figure 22 depicts the number of requirements for each near-space-environment data type. **Data type 11, solar parameters (i.e., solar position, solar radiative flux, sunspot activity, and solar index), has the most current requirements, a total of 5.**

Combined current and potential requirements indicate that data type 11 remains the most required. Data type 19, corresponding to sudden ionospheric storms, is required by six models and simulations if both current and potential requirements are considered. Data types 7 and 10, lunar parameters and radio background noise, respectively, are required by five models and simulations.

Near space data resolution requirements. Respondents to the Requirements Questionnaire have identified resolution requirements for only three of the six models having current requirements for near-space-environment data. **Time resolution requirements have been identified for two models and simulations; horizontal resolution requirements were identified for the other model.** Figure 23 depicts the distribution of the time resolution requirements for near-space-environment data associated with the two models and simulations.

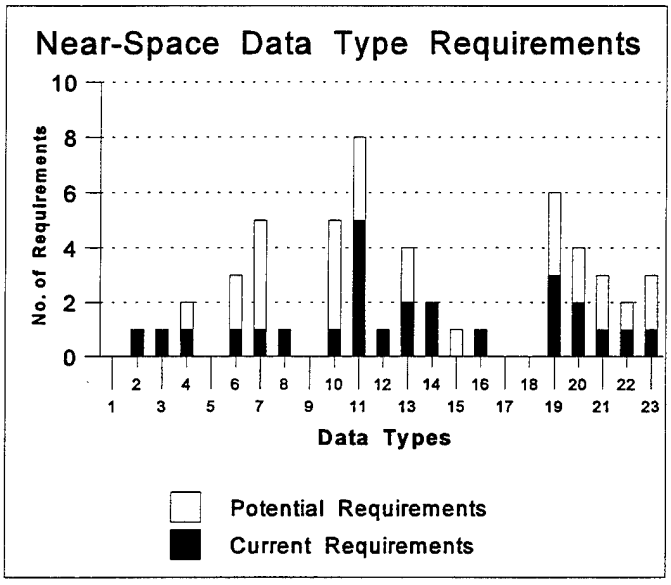


Figure 22. The number of current and potential requirements for near-space-environment data types. Note that the number identifying each data type corresponds to the number of atmospheric data types on the preceding page.

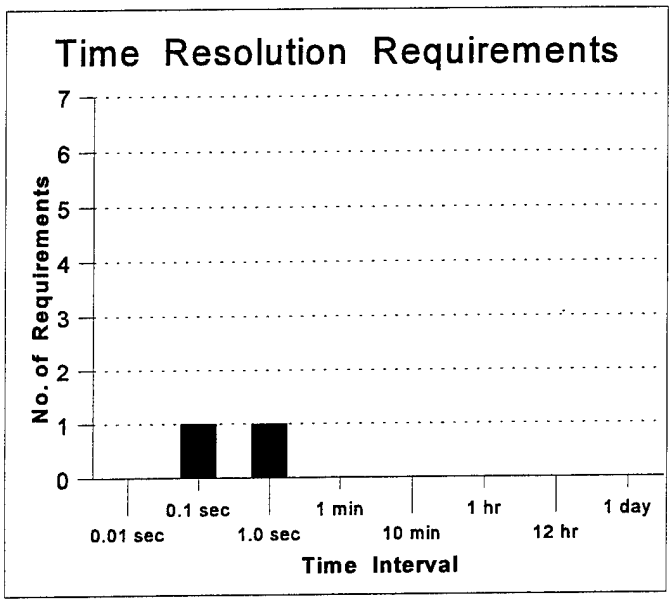


Figure 23. The number of time resolution requirements for specific time intervals.

Near-space-environment effects requirements. Similar to the questions regarding atmospheric effects, the Requirements Questionnaire also posed a series of questions regarding requirements for incorporation of near-space-environment effects into the model or simulation. Again, a series of questions was asked in terms of the effects of the near space environment on a variety of military objects (i.e., forces, platforms, weapon systems, communications systems, and sensors). These five military object families are discussed briefly in Subsection 3.3.5.4.

Figure 24 depicts the results of the responses to the series of questions. For convenience, Figure 24 includes the results shown in Figure 8. Clearly, **the responses indicate that in a small number of models and simulations (three) near-space-environment effects are incorporated.**

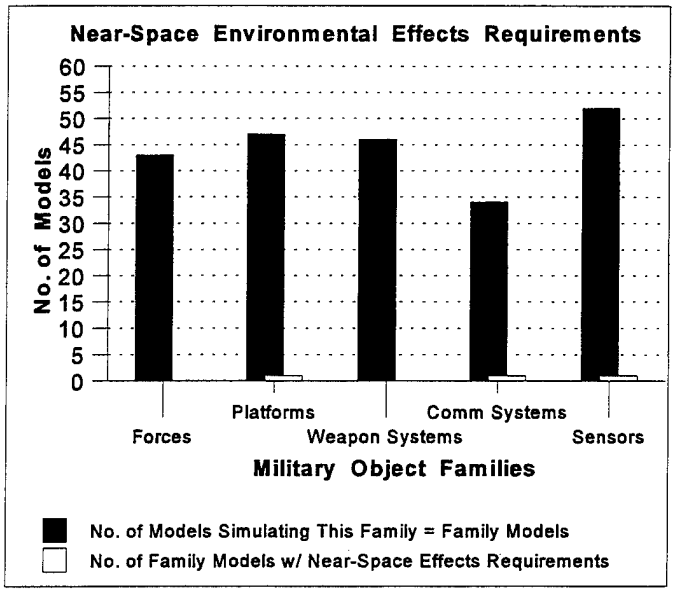


Figure 24. The number of models and simulations incorporating specific military object families and requiring near-space-environment effects.

Other environmental data and effects requirements. The Requirements Questionnaire included a question about requirements for any type of environmental data and effects other than those associated with the atmosphere and near space environment. Responses to this question were received for 39 of the 74 models and simulations. Several of these 39 models identified more than one requirement. The results are shown in Figure 25. "None" in this figure means that no response was received to the question.

Note that 27 requirements were identified as land-related and 43 as ocean-related. The ocean-related requirements should be useful to the MEL Project for its survey effort. A list of models and simulations associated with the 43 ocean-related requirements is contained in Appendix G.

Although the question was focused on environmental data requirements other than those associated with the atmosphere and near space, several responses nonetheless identified requirements related to the atmosphere and near space. A total of 25 data requirements for the atmosphere was tabulated. These requirements have been grouped into two categories, shown in Figure 25 as "Atmosphere-new" and "Atmosphere-redundant." Atmosphere-new means that the respondents identified an atmosphere-related data requirement in responding to the question but did not identify that requirement in Attachment 1 of the Requirements Questionnaire. There are 11 such requirements (e.g., wind speed). Atmosphere-redundant means that the respondents identified an atmospheric data requirement in answering the question and also

identified the same data requirement in responding to Attachment 1 of the questionnaire. These redundant requirements total 14 and include atmospheric data types such as clouds and precipitation.

Two responses identified requirements that were not related to the natural environment. These are shown in Figure 25 as "Nonenvironmental."

3.3.7.3 Other technical requirements

Besides posing questions about the survey effort's primary technical focus (i.e., requirements for atmospheric and near-space-environment data and effects data) the Requirements Questionnaire also posed questions about other requirements of each model or simulation. Such requirements as scalability; compatibility; accessibility; verification, validation and accreditation; and currency were included in the questionnaire. Results associated with each of these other technical requirements are described.

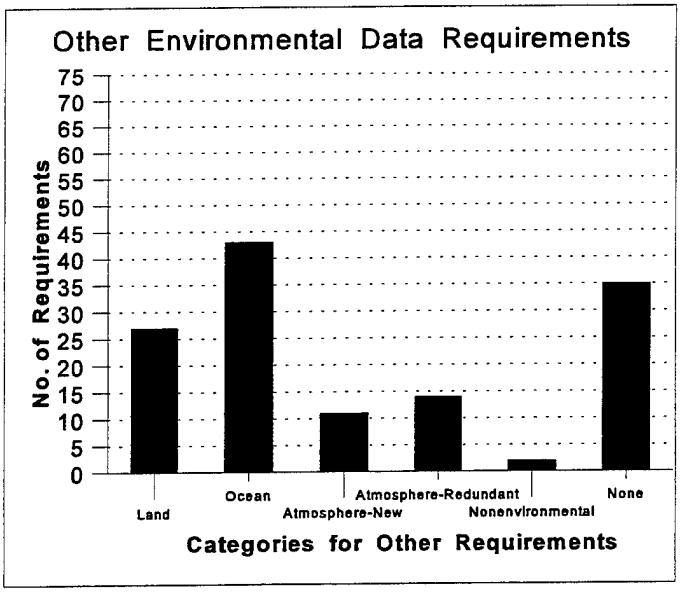


Figure 25. The number of requirements for environmental data other than atmospheric and near space data.

(1) **Scalability requirements**. A question was posed about a requirement for scalability. As indicated in Figure 26, 41 responses (7 yes; 34 no) to this question were received.

Also Figure 26 indicates that only seven models and simulations have a scalability requirement. Of those seven, six respondents provided amplifying information on their scalability requirements. All six responses are quoted below. For comparison, in parentheses after each quotation are references to answers to other questions from the same questionnaire.

- "...grid: 100 to 1, time: 10 to 1"
  (Primary grid types used are DTED Levels I and II. Typical time period is 10 hr; maximum time period is 100 hr.)

- "...1 sec to 300 sec recycle times and higher resolution grid"
  (Several days is the typical time period; the primary grid type used is latitude-longitude.)

- "...continuously variable grid from 1 m to 1000 km"
  (The primary grid type used is Cartesian.)

- "...1-degree x 1-degree data are required"
  (The primary grid is 2.5 deg x 2.5 deg.)

- "...need data for time and location over target"
  (Fourteen atmospheric data types are required; Defense Mapping Agency grids are used for land-based targets.)

- "...12-hr and 1x1 degree grid"
  (Typical time period is 12 hr; typical grid type is 1 deg latitude-longitude.)

(2) **Compatibility requirements**. A series of questions were posed about the software and hardware requirements associated with each model and simulation. The results of the responses to these questions are discussed below.

(3) **Software requirements**. Questions were posed about the operating system, programming languages, database management system, and any near-term changes to any of these three requirements. Figures 27–31 depict the response results.

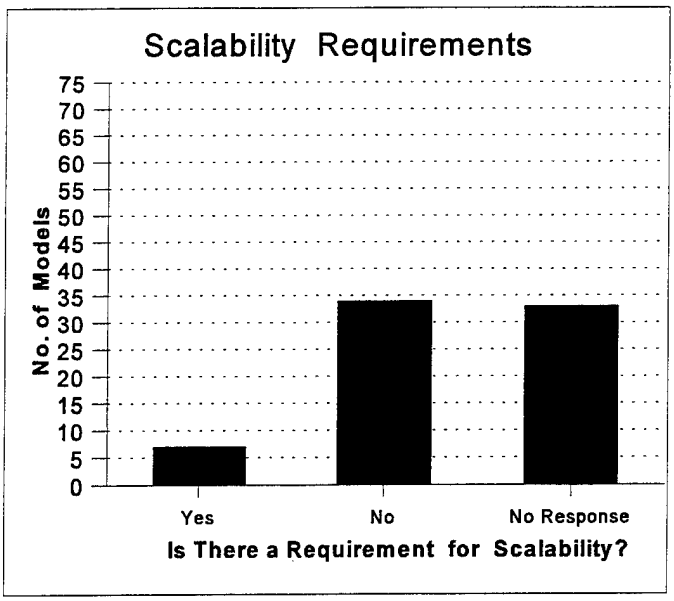


Figure 26. The number of models and simulations having a requirement for scalability.

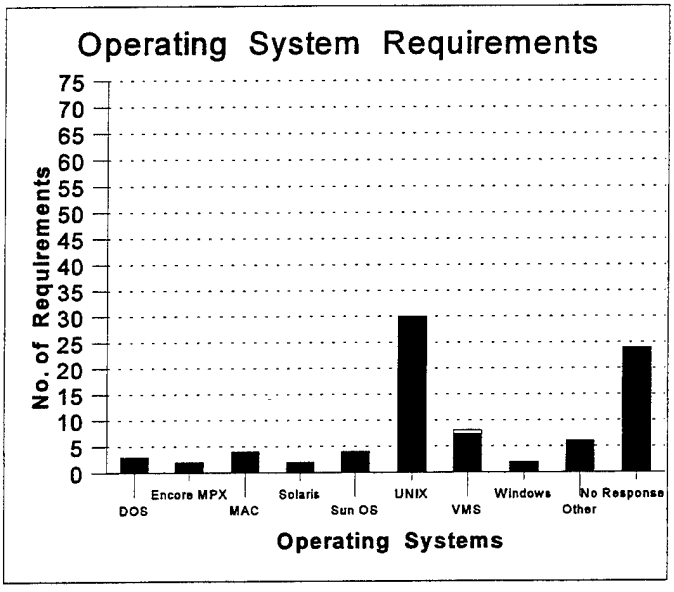


Figure 27. The number of requirements for specific computer operating systems.

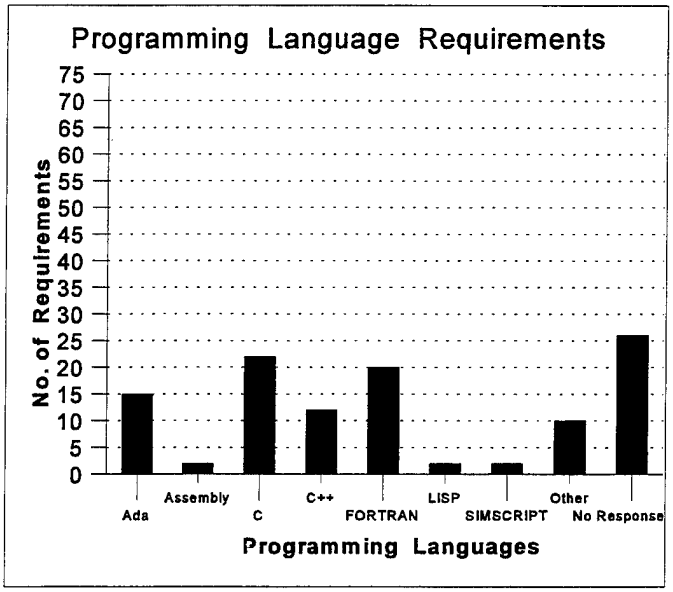


Figure 28. The number of requirements for specific computer programming languages.

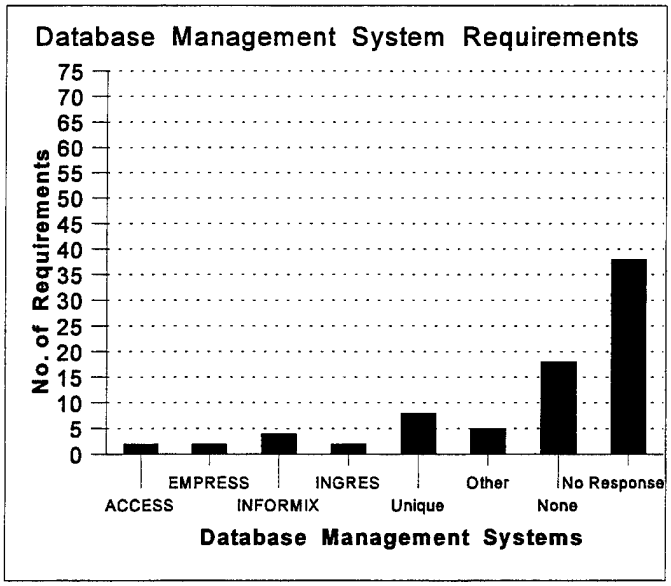


Figure 29. The number of requirements for specific computer database management systems.

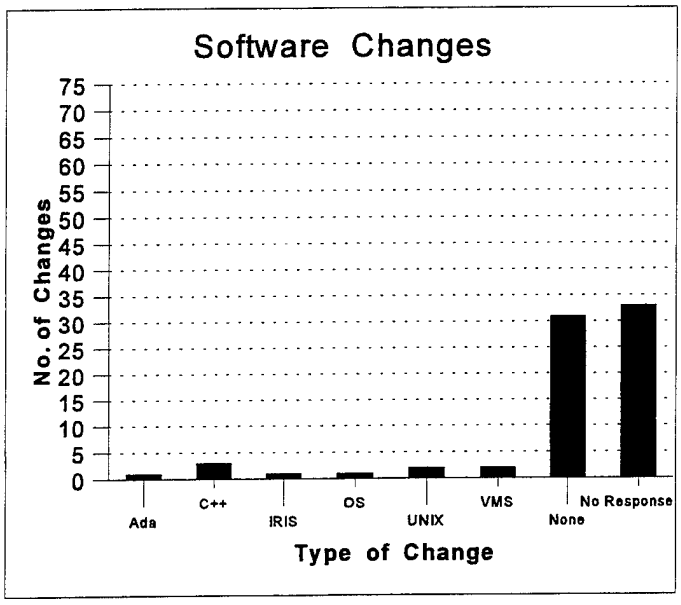


Figure 30. The number of specific software changes planned.

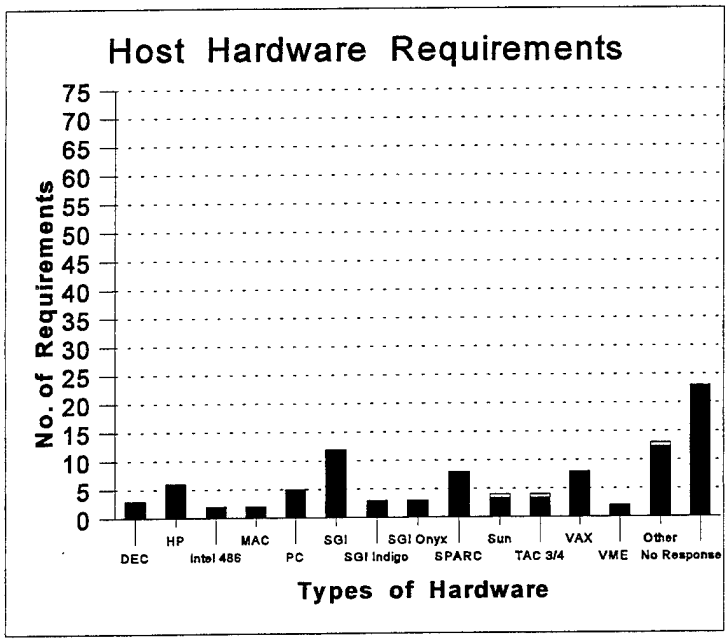


Figure 31. The number of requirements for a specific type of host hardware.

As shown in Figure 27, UNIX dominates the software operating system requirements. Forty-one percent (or 30) of the models and simulations surveyed require and use UNIX. "Other" in this figure includes single requirements for each of the following operating systems: Harris Nighthawk, IRIS, TAC-3, MOTIF, MULTICS, and PRIMOS.

For programming languages, C, FORTRAN, Ada, and C++ dominate the survey set of models and simulations, shown in Figure 28. In the "Other" category are 10 separate requirements: one each for BASIC, COBOL, DCL, LOOPS, OOP, PASCAL, PL/+, MODSIM, Turbo C, and X-Windows.

Database management system requirements show a preference for "unique," meaning that the model or simulation has a uniquely-designed database management system. Figure 29 depicts the distribution of the database management system requirements. Five database management systems are included in the "other" category: ARMS, JMCIS, NEONS, ORACLE, and Sysbase.

Near-term software-related changes, as shown in Figure 30 are few, a total of 10. Forty-two percent (or 31) of the models and simulations are not planned to change in the near term.

Questions were also posed about hardware requirements for the models and simulations in terms of host hardware, transportability, and data media. Figures 31, 32, and 33 depict the response results. Note that in Figure 31 a wide range of host hardware requirements is shown, but the SGI/Indigo/Onyx and Sun/SPARC family types and VAX tend to dominate. Of the 52 responses for the transportability requirements question, 39 models and simulations are shown in Figure 32 to be transportable via the host hardware configuration. As for data media requirements, Figure 33 indicates that nine-track tapes, floppy disks, CD-ROMs, and 8-mm cartridges are predominant.

(4) **Accessibility requirements**. Two questions were posed about accessibility requirements associated with each model and simulation. The first question was concerned with the

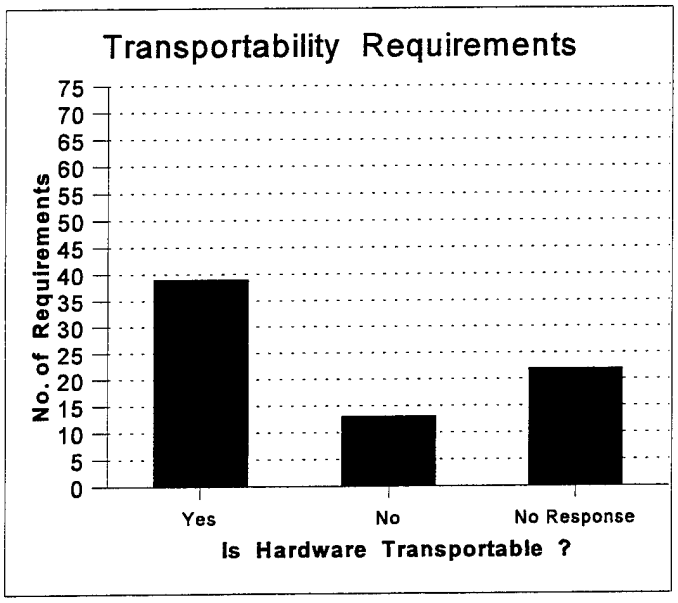


Figure 32. The number of requirements for the hardware associated with the model or simulation to be transportable.

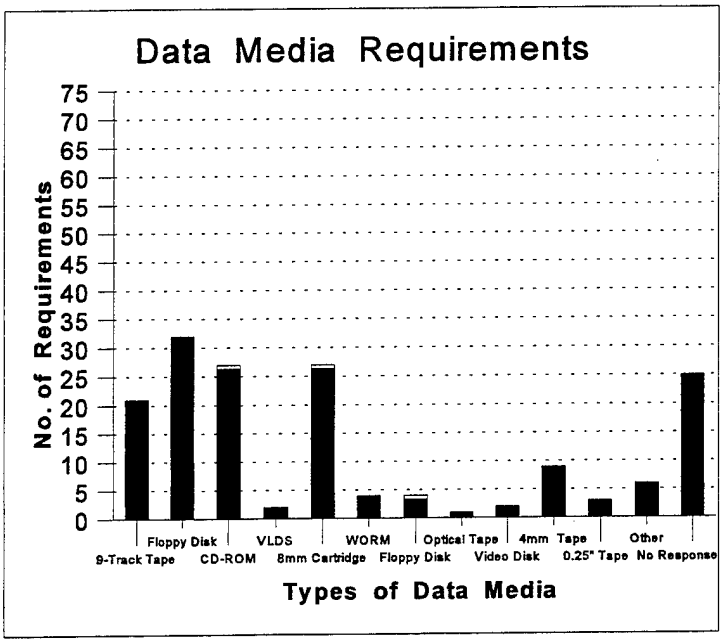


Figure 33. The number of requirements for a specific type of data media.

maximum information security level of the environmental data authorized for use in the model or simulation. Figure 34 indicates that 48 percent, or 25 responses, of the 52 questionnaires responding to the question indicated that environmental data classified to the Secret level are a requirement. The second question related to accessibility, that is, the method or methods of external communications authorized to input data. As shown in Figure 35, the responses do not indicate a dominant type of connectivity requirement. However, if the middle three types are aggregated, a majority of the responses do indicate some type of external connectivity requirement. The "Other" category includes responses such as "LANS, WAN, DIS Node, HSDS, and sat(ellite)", "hard media," "Navy Comm," and "DSI."

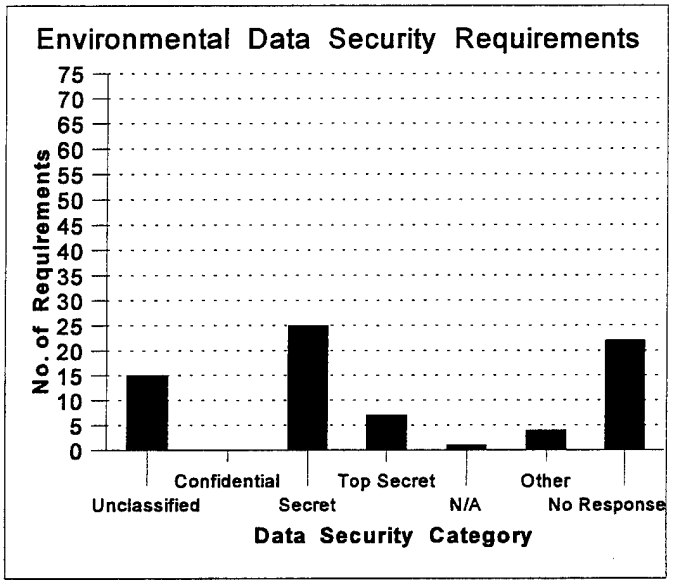


Figure 34. The number of requirements for environmental data used by the model or simulation to be classified at a specific maximum security level.

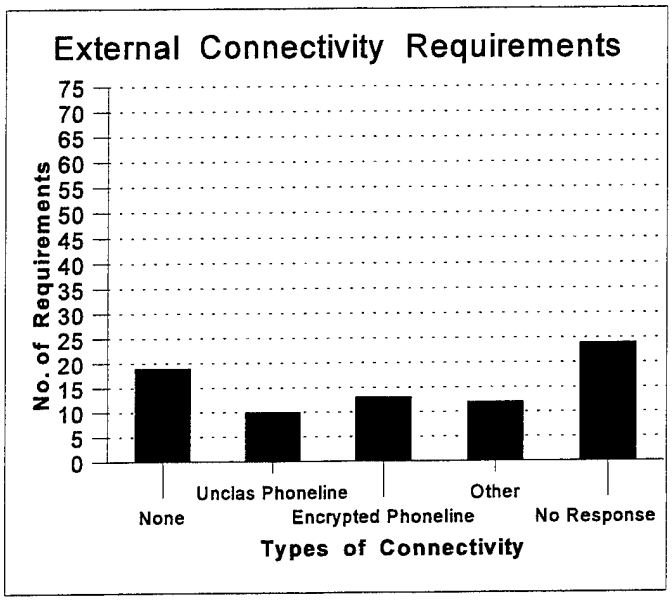


Figure 35. The number of requirements for a specific external connectivity.

(5) **Verification, validation, and accreditation[1] requirements.** Questions were asked about requirements for verification, validation, and accreditation (VV&A) of the atmospheric and near space databases currently being used by the model or simulation. Figure 36 provides the results of the responses to these questions. Note that **a majority of models and simulations do not have requirements for verified, validated, or accredited atmospheric and near space data.**

(6) **Currency of data requirements.** A question was posed about the requirement for the model or simulation to use reasonably current atmospheric and near space data. As shown in Figure 37, slightly more than one-half (25) of those responding indicated a requirement for current data.

---

[1]Well into the survey effort, the DoD via DoD Directive 5000.59 defined "accreditation" in terms of models and simulations, not databases. That is, DoD now defines accreditation as "The official certification that a model or simulation is acceptable for use for a specific purpose." Because the E^2DIS Project Survey Task's Requirements Questionnaire was developed prior to publication of this directive and posed a question about the "accreditation" of atmospheric and near space databases, not models or simulations, some unfortunate confusion could have arisen about the intent of the question. However, the authors, based on many interviews and interactions with the questionnaire respondents, consider the aggregated responses to this question to be reasonable representations of the DoD modeling and simulation community as they apply to databases.

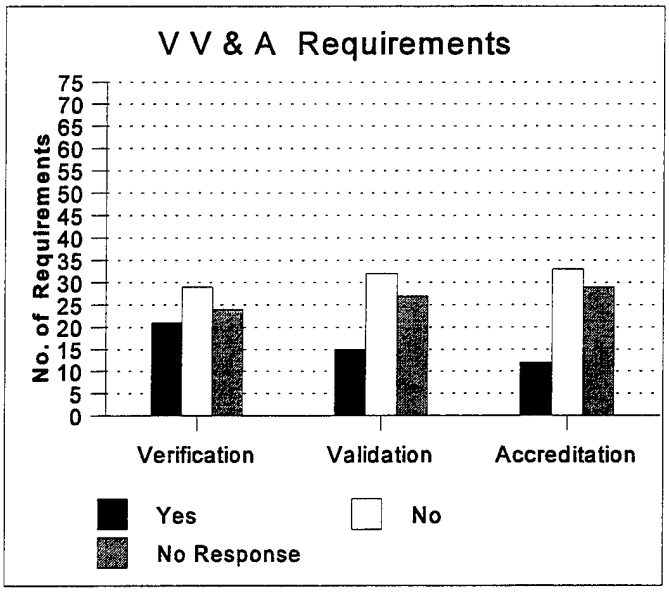


Figure 36. The number of requirements for the models and simulations to have verified, validated, or accredited environmental data.

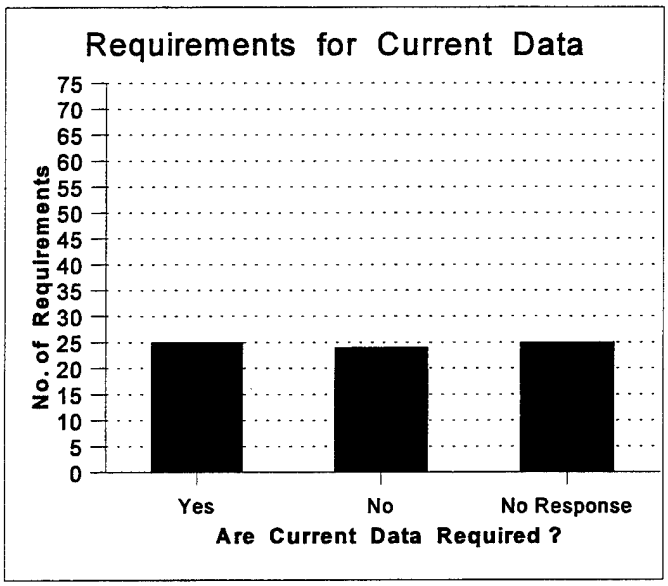


Figure 37. The number of requirements for using current environmental data.

3.3.7.4 Upgrades

An additional set of questions was developed about upgrades to the model or simulation scheduled to occur by FY-97. These questions were generally seeking qualitative answers concerning upgrades and whether any of the upgrades will require new or additional environmental data. Figure 38 indicates that the majority (44) of the models and simulations surveyed are planned for upgrading.

For those 44 models and simulations planned for near-term upgrades, 30 will be incorporating at least one type of environmental data, as shown in Figure 39. Inspection of this figure indicates that atmospheric data type requirements clearly dominate the surveyed set of models and simulations that is planned for upgrades.

3.3.7.5 Briefing

The final question in the Requirements Questionnaire asked the respondents if a briefing on atmospheric and near space parameters, features, processes, and effects would be of interest. As shown in Figure 40, about 60 percent (30 of 51) of the respondents are interested in receiving such a briefing.

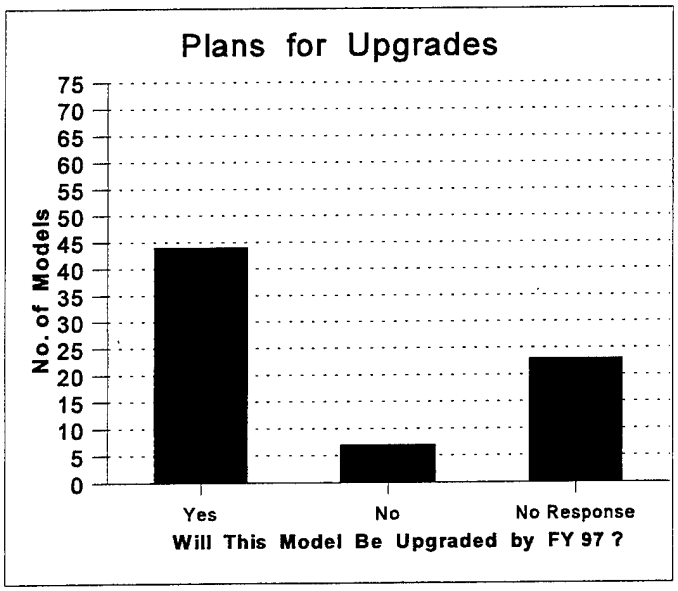


Figure 38. The number of models and simulations planned for upgrading by FY-97.

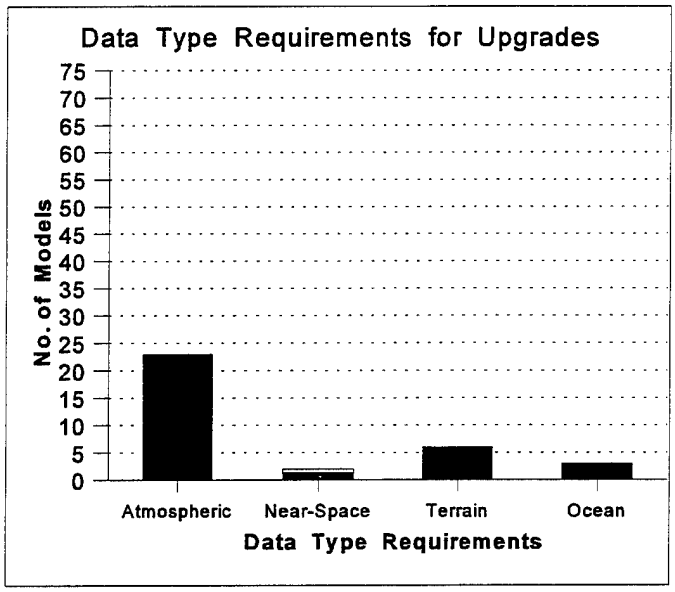


Figure 39. The number of models and simulations being upgraded having specific data type requirements.

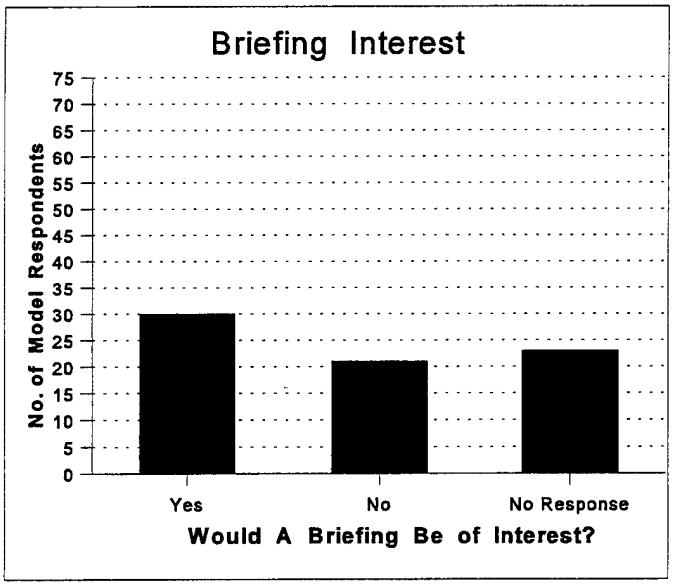


Figure 40. The number of respondents indicating an interest in being briefed on various aspects of the atmosphere and the near space environment and its effects.

4. CASE STUDY FOR THE WIND ATMOSPHERIC DATA TYPE

Section 3 presented responses to the individual questions in the Requirements Questionnaire. In that section, one of the atmospheric data types, wind, was found to be the most predominant data type in the surveyed set of 74 models and simulations. Section 4 focuses on examining the relationships and applications of the wind atmospheric data type in the models and simulations of the Requirements Survey database. Both current requirements and potential requirements for incorporating the wind atmospheric data type are considered.

4.1 FUNCTIONAL AREA AND HIERARCHICAL LEVEL

Table 8 presents the distribution of current requirements for the wind atmospheric data type among the 74 models and simulations according to functional area and hierarchical level. It is in the same format as Table 2, which presents the distribution of all 74 models and simulations. The numerator for each block indicates the number of models and simulations having current requirements for the wind atmospheric data type. The denominator is the total number of models and simulations for that block from Table 2.

Note, in general, that the majority of **Research and Development models and simulations have requirements for the wind atmospheric data type, but the majority of Analysis and Military Operations models and simulations do not.** This latter result is somewhat counterintuitive because wind often affects military operations in the real world. **Especially note that none of the Campaign-level models and simulations have incorporated the wind atmospheric data type, and less than one-half of the Mission-level models have.** This result is also unexpected.

If potential requirements, as well as current requirements, for the wind atmospheric data type are considered, the following distribution shown in Table 9 occurs. Almost all (85%, or 11 of 13) of the Research and Development models and simulations have requirements for the wind atmospheric data type, whereas **Analysis models and simulations in particular continue to have substantially few requirements for this data type.** Also note that **Campaign-level models and simulations continue to lack requirements for the wind atmospheric data type even when potential requirements are included.** On the other hand, 81 percent (13 of 16) of the Mission-level models and simulations have wind atmospheric data type requirements, and, moreover, at the Mission-level **all** Research and Development, Military Operations, and Education and Training models and simulations have requirements for this data type.

Table 8. Models and Simulations Having Current Requirements for the Wind Atmospheric Data Type (Wind/Total)

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			0/4		0/2	0/3	0/9
Mission	2/4		0/3	1/2	1/3	3/4	7/16
Many-on-Many / Few-on-Few	2/3	1/2	3/6		4/8	2/3	12/22
1-on-1	0/1	4/8	1/4		0/1	4/6	9/20
Engineering	4/5		1/2				5/7
Totals	8/13	5/10	5/19	1/2	5/14	9/16	33/74

Table 9. Models and Simulations Having Current Requirements and/or Potential Requirements for the Wind Atmospheric Data Type (Wind/Total)

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			1/4		0/2	1/3	2/9
Mission	4/4		1/3	1/2	3/3	4/4	13/16
Many-on-Many / Few-on-Few	2/3	2/2	3/6		6/8	2/3	15/22
1-on-1	0/1	6/8	1/4		0/1	5/6	12/20
Engineering	5/5		1/2				6/7
Totals	11/13	8/10	7/19	1/2	9/14	12/16	48/74

4.2 SIMULATION TYPES

In Section 3.3.5.2, the distribution of the 74 models and simulations surveyed is presented in terms of three types: live, virtual, and constructive. Figure 41 depicts this same distribution, but separates the models and simulations associated with each type into three groups: the number of models with current requirements for the wind atmospheric data type, the number of models with potential requirements for the wind atmospheric data type, and the number of models that have no requirements for the wind atmospheric data type.

One of the interesting, and somewhat perplexing, results from this distribution is that the majority of live simulations, that is, five of eight, do <u>not</u> have current or potential requirements for the wind atmospheric data type. This result is considered perplexing because, in the real world, wind conditions, benign or otherwise, always exist. If a live play simulation has no requirement for the wind atmospheric data type, it could imply that the planning, as well as the execution, of the simulation takes place without consideration of the wind factor. **The lack of wind atmospheric data type requirements for most of the live play simulations surveyed is unexpected and should be the focus of a followup effort.**

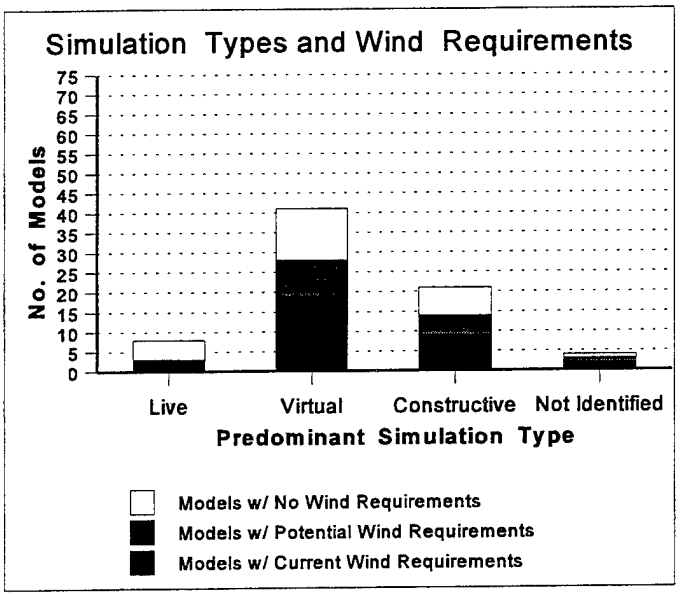


Figure 41. The number of models and simulations having current and potential requirements for wind, grouped by type (i.e., live, virtual, constructive).

4.3 CRITICAL ENVIRONMENTAL FACTORS

Section 3.3.2 indicates that 54 of the 74 models and simulations surveyed have been identified to have critical environmental factors. Table 10 presents the distribution of current requirements for the wind atmospheric data type among those 54 models and simulations having critical environmental factors. The 32 models and simulations having current requirements for wind are identified to have critical environmental factors. **A comparison of Table 10 with Table 8 shows that 32 of the 33 models and simulations having current requirements for the wind atmospheric data type also are identified to have critical environmental factors.**

In Table 10, however, a significant difference between the Research and Development models and simulations and the Analysis models and simulations is observed. All but two of the Research and Development models and simulations identified to have critical environmental factors have current requirements for the wind atmospheric data type. Conversely, **Table 10 indicates that only 4 of 13 Analysis models and simulations having critical environmental factors have current requirements for the wind atmospheric data type.** Another result shown in Table 10 is that none of the Campaign-level models and simulations having critical environmental factors require the wind atmospheric data type.

Table 10. Models and Simulations Having Critical Environmental Factors and Current Requirements for the Wind Atmospheric Data Type (Wind/Total)

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			0/2		0/1	0/2	0/5
Mission	2/3		0/3	1/2	1/1	3/3	7/12
Many-on-Many / Few-on-Few	2/2	1/2	3/3		4/5	2/2	12/14
1-on-1	0/1	4/6	0/3		0/1	4/6	8/17
Engineering	4/4		1/2				5/6
Totals	8/10	5/8	4/13	1/2	5/8	9/13	32/54

If potential requirements for the wind atmospheric data type are included with its current requirements, 39 of the 54 models and simulations having critical environmental factors require the wind atmospheric data type. Table 11 presents the distribution of these combined requirements for this data type.

As a result of combining potential and current requirements, all the many-on-many and few-on-few models and simulations having critical environmental factors also require the wind atmospheric data type. Likewise, by including potential requirements for this data type all but one of the Research and Development and one of the Test and Evaluation models and simulations having critical environmental factors require the wind atmospheric data type as well. On the other hand, the Analysis models and simulations having critical environmental factors continue to be low in number (38%, or 5 of 13) as do the Campaign-level models and simulations (20%, or 1 of 5).

Table 11. Models and Simulations Having Critical Environmental Factors and Current and/or Potential Requirements for the Wind Atmospheric Data Type (Wind/Total)

Model / Simulation Hierarchical Level	DMSO Functional Areas						Totals
	Research and Develop-ment	Test and Evaluation	Analysis	Production and Logistics	Military Operations	Education and Training	
Campaign			0/2		0/1	1/2	1/5
Mission	3/3		1/3	1/2	1/1	3/3	9/12
Many-on-Many / Few-on-Few	2/2	2/2	3/3		5/5	2/2	14/14
1-on-1	0/1	5/6	0/3		0/1	5/6	10/17
Engineering	4/4		1/2				5/6
Totals	9/10	7/8	5/13	1/2	6/8	11/13	39/54

4.4 MILITARY OBJECT FAMILIES MODELED AND ATMOSPHERIC EFFECTS

In Section 3, Figure 20 presented the number of models simulating atmospheric effects for each of five military object families: forces, platforms, weapon systems, communications systems, and sensors. Figure 42 replicates this information and provides additional information on those models having current requirements for the wind atmospheric data type and those models having current requirements for both atmospheric effects and the wind atmospheric data type.

As shown in Figure 42, models simulating forces, platforms, and weapon systems tend not to have any atmospheric effects requirements but tend to require the wind atmospheric data type. Models simulating communication systems and sensors, on the other hand, have a tendency to require both the wind atmospheric data type and atmospheric effects. This is somewhat perplexing, since wind generally has a direct effect on the performance behavior of forces, platforms, and weapon systems, but only has an indirect effect on the performance of communication systems and sensors. One explanation might be that the models simulating atmospheric effects on communication systems and sensors are appropriate considering the indirect wind effects, such as moving dust and sand into the path of operation for these

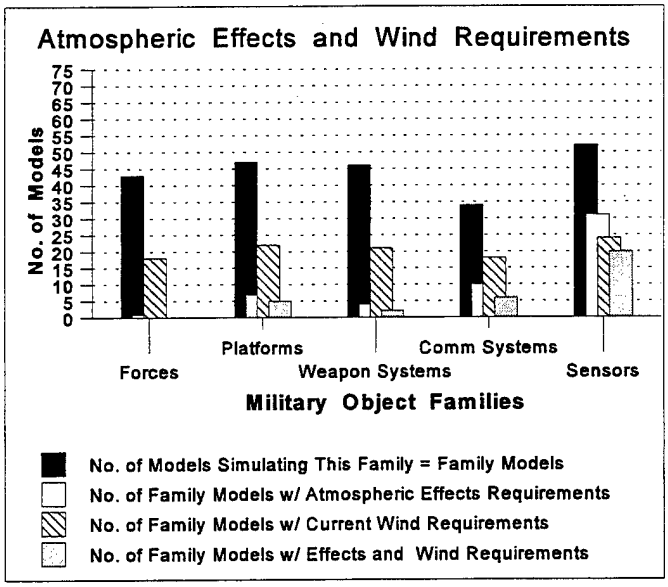


Figure 42. The number of models and simulations incorporating military objects (i.e., forces, platforms, weapon systems, communication systems, and sensors) compared to those with atmospheric effects requirements, current wind requirements, and a combination of both.

systems and sensors, whereas the direct effects of wind on the performance of forces, platforms, and weapon systems are being neglected for some reason. This perplexing set of results is an issue that should warrant further research and analysis.

4.5 RESOLUTION REQUIREMENTS

Section 3 described the horizontal, vertical, and time resolution requirements for all atmospheric data types in the surveyed set of 74 models and simulations. Figures 43, 44, and 45 illustrate the resolution requirements for the wind atmospheric data type and compare them to the resolution requirements for all the atmospheric data types.

It is evident and quite striking that from all three figures (Figures 43–45), with only a few exceptions, horizontal, vertical, and time resolution requirements for the wind atmospheric data type exactly match those for all of the atmospheric data types. This result apparently indicates that most models and simulations treat these atmospheric data types at the same spatial and temporal resolution.

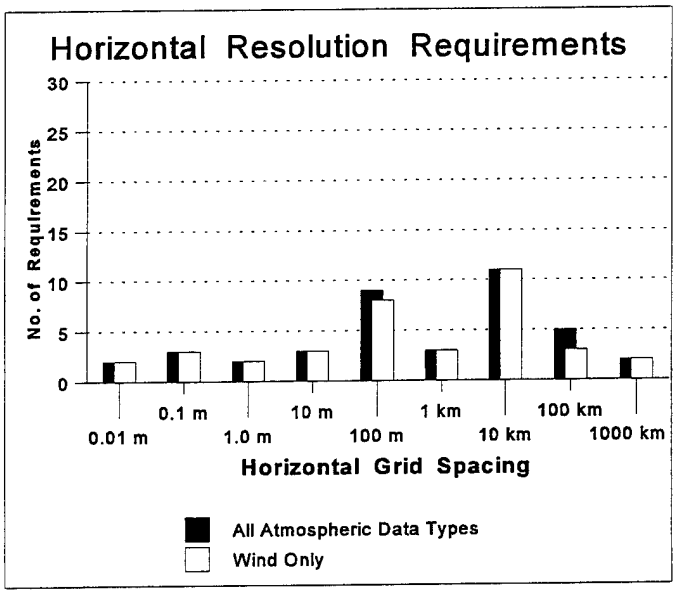


Figure 43. The number of horizontal resolution requirements for all atmospheric data types compared to the horizontal resolution requirements for the wind data type only.

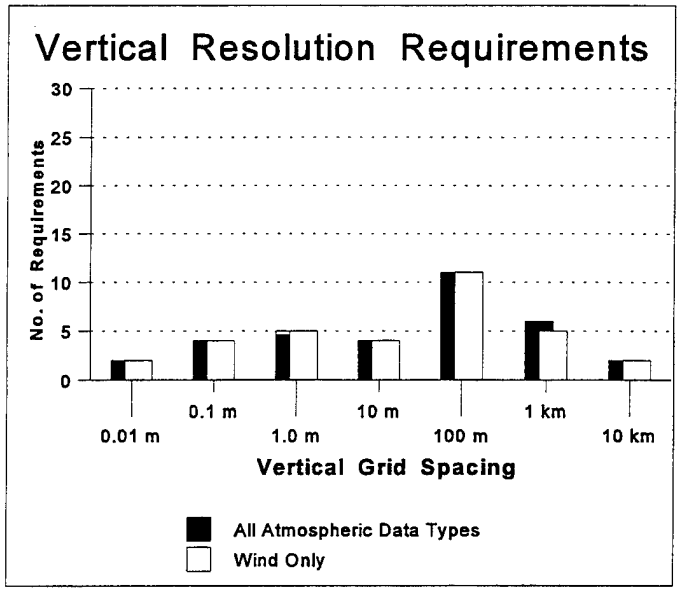


Figure 44. The number of vertical resolution requirements for all atmospheric data types compared to the vertical resolution requirements for the wind data type only.

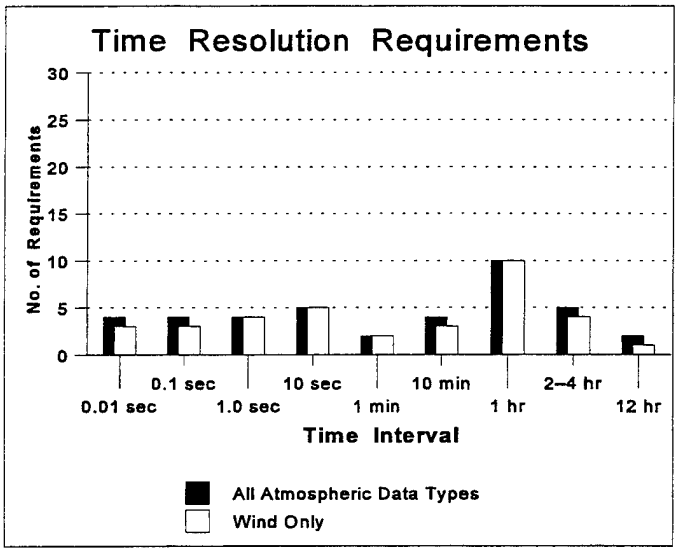


Figure 45. The number of time resolution requirements for all atmospheric data types compared to the time resolution requirements for the wind data type only.

5. FINDINGS

Quantitative results from the requirements survey effort were presented in Sections 3 and 4. Section 5 focuses on identifying and describing the qualitative findings made during the same survey effort. These findings are generally based on discussions held during briefings and interviews with technical experts for the models and simulations, as well as the Survey Task Team's reviews of documentation associated with a specific model or simulation. Together with the previously cited results, the following findings provide the basis for recommendations made in Section 6.

5.1 MAJOR MODELS AND SIMULATIONS

As indicated in Section 2, **lists of the major M&S efforts in each Service were not available to the Survey Task Team at the start of the Requirements Survey.** Several lists of models and simulations were readily available from a variety of sources, such as from the Services' M&S offices. However, there was no list from any of the Services that only identified major models and simulations. From a cost-effectiveness standpoint, a list of the major models and simulations would speed the scoping process for any project assigned to describe key aspects of the Services' modeling and simulation efforts. Such a list would also be valuable because, if major M&S efforts were clearly identifiable, any project involving these efforts would likely be viewed as having more credibility than another project that was not involved with the major M&S efforts. Ongoing efforts by the Military Services to create complete accountings of M&S status, especially for their major models and simulations, should continue. This report is designed to aid in those efforts.

In lieu of any authoritative listings, the Survey Task Team compiled an *ad hoc* list of major models and simulations from many sources. Chief among the sources were the Services' principal points-of-contact for modeling and simulation. Other sources included individual service organizations, returned questionnaires, and articles in military-related periodicals and journals. Periodically during the Requirements Survey effort, Survey Task Team members discussed the *ad hoc* list with the Services' principal M&S offices. For this Survey Task, the *ad hoc* list of the Services' M&S efforts became a *de facto* list of their major M&S efforts. Appendix E contains a list of the Services' M&S efforts identified during the course of this survey.

5.2 AWARENESS OF THE NATURAL ENVIRONMENT

Another important finding that the Survey Task Team has identified is **the need for making the M&S community aware of the natural environment and its effects on military forces, platforms, weapon systems, sensors, and communication systems.** This appears to reflect a pervasive need for all the Services.

Two symptoms underscore the need for such awareness. One symptom, poor response to questions on the natural environment and its effects, was expected to some degree by the Survey Task Team at the beginning of the survey effort. The other symptom, inconsistency of applying the natural environment and its effects within a given model, was not expected.

Regarding the first symptom, the Survey Task Team expected that some points-of-contact would not be familiar with environmental effects in general and, therefore, not familiar with the potential value of including such effects in their models and simulations. As part of the survey strategy, followup interviews were planned to offset this anticipated shortfall. It must be noted that some Service individuals were, indeed, quite knowledgeable and articulate on the subject of the natural environment and its effects on military systems. But, these were the exception; the majority of those interviewed required detailed discussions about the natural environment and its effects on the performance of forces, platforms, and systems.

The second symptom, inconsistency of applying the natural environment and its effects within an individual model, was discovered by a Survey Task Team member when reviewing documentation associated with several models and simulations. Such documentation included system specification documents, technical manuals, and user manuals that describe a given model or simulation in some detail, in terms of very specific technical parameters required for the model or simulation to function and in terms of the algorithms that are incorporated into the model or simulation. In one case, a very sophisticated flight simulator has options to incorporate several atmospheric conditions and effects, such as clusters of rain-producing clouds, surface wind direction and speed, and the ducting of electronic signals emanating from a fictitious enemy's fire control radar, into a training scenario. However, each condition and effect is a separate, independent option selectable by the instructor. The possibility exists that the various environmental options can be selected without consideration of any realistic consistency for the set of options. Consequently, for those times when unrealistic sets of options are selected, the student pilot will be undergoing negative training by flying in an unrealistic, simulated atmospheric environment.

In another case exemplifying an inconsistent application of environmental effects in a single model, a Survey Task Team member reviewed documentation of a theater-level warfighting model. The review indicated that an algorithm associated with the effectiveness of land forces includes a term that depends upon time of day. However, no equivalent algorithm is available that affects simulated naval forces and air forces in the model. In addition, the same model has distinctly different concepts for the effectiveness of sensors that detect targets in an ocean environment and sensors that operate in the atmosphere. For sonars, assigning an explicit environmental effects factor (i.e., propagation loss of sound energy) is permitted for each model run. For ground-based radars, no explicit atmospheric effect factor can be found in any of the target detection algorithms that model the performance of those radars. The possibility exists, however, that atmospheric effects might be included implicitly by considering the effect the atmosphere has on various performance factors, such as radar range, in the probability-of-detection algorithms. No assurance can be given, however, that even if such a consideration occurred, any consistency in applying such implicit atmospheric effects would be invoked for each of the several ground-based radars during a given model run.

5.3 CONCEPTS AND DEFINITIONS

Because of the recurrence of the first symptom, poor response to questions on the natural environment and its effects, the Survey Task Team sought to use a simple, basic diagram, or "roadmap" (which is discussed further in the Team's third document, "An Analysis of Requirements Versus Capabilities") to assist in familiarizing M&S technical experts with the concept of environmental effects and their relation ship to warfighting models and simulations. An expeditious search for such a conceptual diagram among the M&S community and the environmental science and support community indicated that none was readily available. **This finding, the nonavailability of a simple conceptual diagram, which is a very basic system engineering tool from the M&S community, only reinforced the Survey Team's notion that the M&S community had in general a fundamental lack of awareness and understanding of the interplay of environmental effects in its models and simulations. Similarly, the lack of such a fundamental tool from the environmental science and support community also reinforced another notion: that the Services' environmental science and support community does not adequately understand the basics of linking with the M&S community.** Consequently, the Survey Task Team developed a simple conceptual model of relating environmental effects with warfighting models.

Figure 46 depicts the Survey Task Team's conceptual model that was developed and used in numerous briefings, interviews, and discussions with the M&S community's technical experts during the Requirements Survey effort. It shows the major components associated with military M&S and environmental modeling efforts. Supplementary charts for this diagram have also been constructed to describe each major component block in more detail. They are included in Appendix H of this document.

The Survey Task Team found Figure 46 and the supplementary conceptual model diagrams to be useful during the course of the numerous interactions with the M&S technical experts. However, these diagrams are not to be construed as authoritative, yet. They were formulated for a specific reason in a rather expeditious manner. Peer review and acceptance need to occur before any authoritative labeling can be applied.

Note that the component "environmental impact models" is included in Figure 46. Although the survey effort is focused on requirements for the **effects** of the atmosphere and near space environment, it also became apparent during briefings and discussions that both the M&S community and the environmental science and support community occasionally interchanged the terms "environmental impacts" and "environmental effects." This interchanging of terms is somewhat unfortunate because it tends to invite additional confusion, rather than less (counter to what the Survey Team was attempting to do), in explaining the concept of environmental effects.

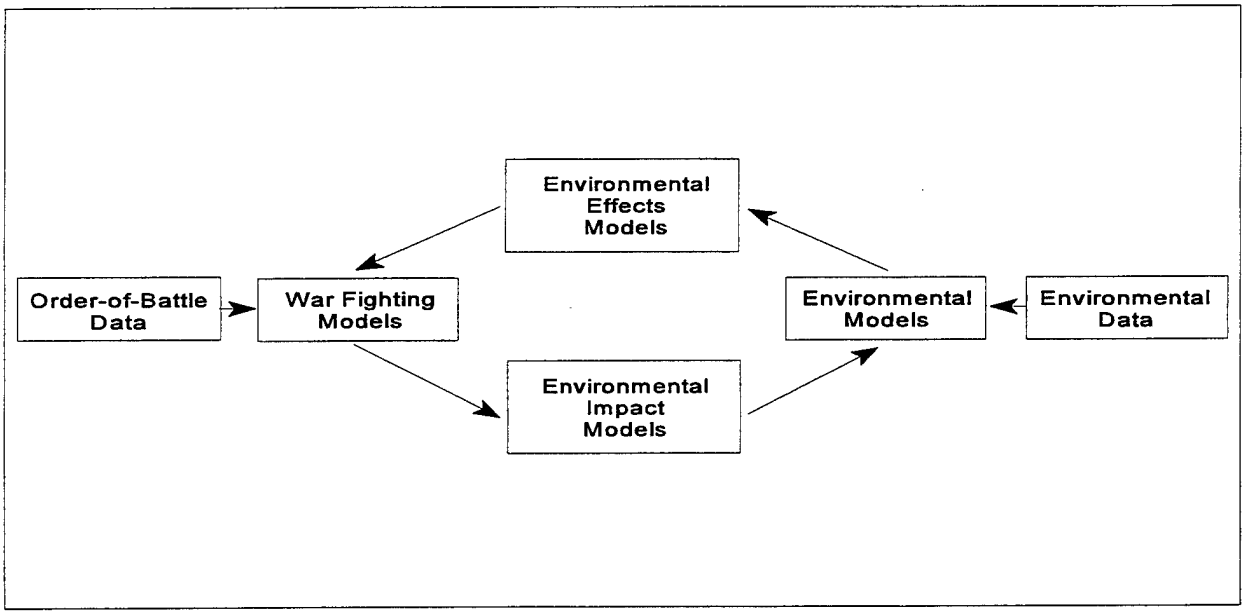


Figure 46. Major components of military simulations.

In order to avoid any further confusion and maximize the probability that all parties in a briefing or interview understood the concept of environmental effects as opposed to environmental impacts, the Survey Task Team sought definitions for both terms from an authoritative M&S source. The only definition available was for environmental effects and that was from the draft "Distributed Interactive Simulation (DIS) Atmosphere and Near Space Environmental Representation Rationale" document (Distributed Interactive Simulation Atmosphere Subgroup, 1994). The draft definition for environmental **effects** reads "The impact that the environment or environmental feature has on some component or process in the simulation exercise, such as the propagation of energy and image formation, the performance of a weapon system, platform or sensor, or other non-visualized combat processes." Since the definition uses the term impact, it can cause some confusion to the uninitiated. In addition, it is not all inclusive. The natural environment can affect itself; for example, rain can wet dry soil and wind can cause waves on the ocean surface. Hence, to improve upon this definition and to include the notion of environmental impact, the Survey Team developed a simple concept diagram that helped to distinguish the two terms. The diagram is shown as Figure 47.

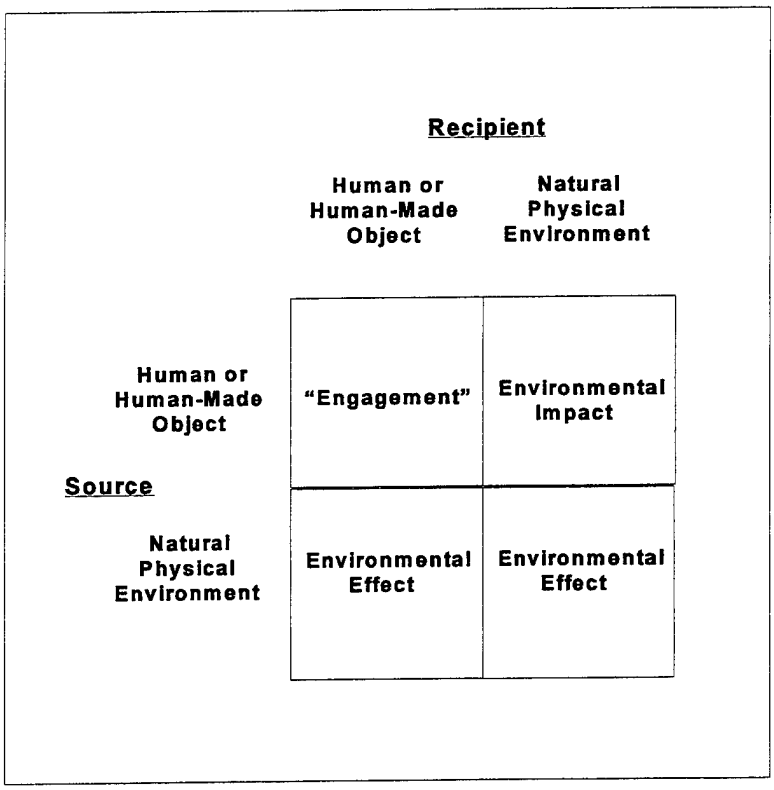


Figure 47. Names of object interactions.

Implied in Figure 47 is the simple assumption that there are basically two classes, or families, of objects to consider: human or human-made objects, and natural physical environment objects. One object class is the source of an interaction and the other is the recipient. An "engagement" occurs when a human or human-made object interacts with another human or human-made object, for example, when a ground force attacks an enemy ground force. When a human or human-made object interacts with the natural environment, an "environmental impact" occurs. In a battle situation, this interaction typically can occur as a byproduct of the ground forces' engagement. For example, one ground force might fire artillery shells at the opposition and, besides attriting the enemy, cause both cratering and dust clouds in the battlespace. The cratering resulting from the battle is potentially a longer term impact on the land environment than the dust cloud dispersed into the atmosphere. Nonetheless, both are environmental impacts, changes in the natural physical environment caused by human military forces.

Taking the draft DIS definition and clarifying it somewhat in terms of the two object classes, an environmental effect occurs when the natural physical environment interacts with a human or human-made object and causes some change in its state or behavior. For example, rain or snow might interfere with (i.e., scatter) electromagnetic energy emanating from an air search radar. The natural physical environment can also interact and affect itself. The wetting of soil during a rainstorm is an example of this type of environmental effect.

Based on the preceding discussion regarding Figure 47 as background, the following definitions could improve not only the understanding of concepts, but also the addressing of requirements issues for both the M&S community and the environmental science and support community in the Services:

- **Environmental Effect. (1) Any result caused by the natural environment when interacting with a human or human-made entity. Examples are the ducting of a sonar's acoustic energy caused by the ocean's vertical density structure; the deflection of a ballistic missile's trajectory due to atmospheric wind and density conditions; and, the reduced movement of tanks on rain-softened soil. (2) The result of an interaction between the environment and itself. Examples are the wetting of soil by rain, wind-blown dust, and ocean waves. Either environmental effect type, (1) or (2), may be transitory or permanent.**

- **Environmental Impact. Any result caused by a human or human-made entity when interacting with the simulation's natural environment. Such a result may be planned**

or accidental, transitory or permanent. Examples are bomb craters in the vicinity of an airfield, cooling of the battlespace atmosphere due to human-made smoke, and the defoliating of trees by human-made chemical agents.

5.4 EXPLICIT AND IMPLICIT REQUIREMENTS

Late in the survey effort, the Survey Task Team became aware of another interesting and important finding. This finding was stimulated during a review of technical documentation associated with a theater-level warfighting model that incorporated some atmospheric effects and oceanographic effects explicitly. That is, the model has an explicit requirement for specifying the local time for daylight hours and nighttime hours. This specific requirement is used in an algorithm that applies daylight hours and nighttime hours to factors contributing to the relative effectiveness of ground forces. Similarly, the model requires an explicit specification of oceanographic-related data that contributes to factors in an algorithm characterizing the probability of detection of submerged enemy submarines and other targets. Both of these algorithms in the model explicitly require specific environmental data that are used to affect the outcome of various military object interactions during the course of executing the model.

Explicit requirements for environmental data, such as those described in the preceding paragraph, are typically the focus of surveys. This survey effort was no different. However, **further review of the model's documentation indicated the interesting finding that the model could also have <u>implicit</u> requirements for environmental data.** For several algorithms, the model applies probability functions to calculate results of military object interactions, such as the detection of enemy aircraft by ground-based air defense radars. Although no requirements exist for such algorithms to accept explicitly atmospheric data, there is, nonetheless, an implicit requirement for considering the effect of the atmosphere on the propagating radar energy. That is, the explicit, nonenvironmental input factor, radar range, is, in the real world, always affected by atmospheric temperature, water vapor, and precipitation. Regardless of whether such atmospheric data types are considered, assumed, or even ignored, the radar range factor for the algorithm, hence, the algorithm *in toto*, has the implicit requirement for that atmospheric data.

This survey effort focused exclusively on the explicit requirements for atmospheric and near-space-environment data. Implicit requirements may be equally as important as explicit requirements when considering the interactions associated with a given model or simulation. Additional research would be required to confirm this speculative notion.

Regardless of whether explicit or implicit requirements for the atmosphere and near space environment need to be considered for an M&S effort, **the Survey Task Team's experience indicates that a need exists for a consistent, institutional approach in identifying requirements for environmental effects and environmental data. One method that the Survey Task Team proposes is to associate an "environmental sensitivity" descriptor with each object in the model or simulation.** Such a descriptor would provide a means to characterize each object's sensitivity to the effects of specific natural environmental phenomena or conditions. Hence this characterization could assist M&S participants in considering the more subtle requirements as well as the more profound requirements for environmental effects and environmental data during the important initial planning of an M&S effort.

6. SUMMARY

Section 1 of this document introduced the Requirements Survey Task effort that is part of the DMSO-sponsored E^2DIS Project. In that section, the background, purpose, and scope for the Survey Task, in general, and the Requirements Survey, in particular, were presented. The Requirements Survey was initiated to baseline the current situation regarding the incorporation of the atmosphere and near space environment in military models and simulations. A strategy, described in detail in Section 2, provides the methodology that the Survey Task Team applied in conducting its effort to collect requirements-related data for baselining the current situation. This strategy included developing and using a questionnaire to record the requirements data. Section 3 presented the quantitative results of collecting requirements data for both the atmosphere and near space environment. Section 4, a case study, specifically focused on requirements for one atmospheric data type: wind. Section 5 documented in a qualitative sense four important issues that became apparent during the survey effort.

In this section, first is provided a summary of the results gleaned from an analysis of the questionnaire responses. The second subsection provides a review of the case study on the wind atmospheric data type, and the third subsection provides a summary of the qualitative findings from the survey effort. The final subsection provides comments and recommendations based on the results, the case study, and the findings.

6.1 RESULTS

The 74 models and simulations, for which requirements questionnaires were returned and the responses analyzed, represent all of the DMSO functional areas and Air Force hierarchical levels for models and simulations. (The functional areas and hierarchical levels are identified in Subsection 3.3.1.) Authoritative documentation exists for 76 percent of the 74 models and simulations. Of the 74 models and simulations, 73 percent (or 54) have been identified to have **critical environmental factors**. Of these 54 models and simulations, 63 percent have critical environmental factors documented. **It is noteworthy that only 60 percent of the Military Operations models and simulations were identified as having critical environmental factors.** This is somewhat perplexing inasmuch as the Services' warfighters should be the principal beneficiaries of the results of these Military Operations models and simulations, and the warfighters are generally sensitive to the effects that the environment can play on their operations.

Today, about 60 percent of the models and simulations are operational, increasing to over 90 percent by FY-97. Most (57 percent) will be involved with DIS by FY-97. The majority (57 percent) of the surveyed models and simulations are virtual, 28 percent are constructive, and 11 percent are used for live play. For the 64 questionnaires with responses to a question about applications supported by the model or simulation, an almost equal number supported two of three types of applications: sensor acquisition of targets, and decision aids for command and control. (The third type of application is mobility of forces and platforms.) Military object families (i.e., forces, platforms, weapon systems, sensors, and targets) are modeled by about 40–50 of the models and simulations. Military missions are included in over 60 models, and communication systems are included in less than 35 models and simulations.

Questions were posed about requirements for **domains**: horizontal surface, vertical, and time. Global, land-related, and littoral comprise the majority of the horizontal surface domain requirements. For the vertical domain, the atmosphere and land surface are clearly dominant. Generally, the models and simulations surveyed indicate a marked preference for time periods on the order of minutes, hours, or days, as opposed to seconds or weeks. The models and simulations use a variety of **grids and map projections**; latitude-longitude and Cartesian grids and mercator projections are preferred but not overwhelmingly so.

One of the more surprising results is that 40 percent (or 30) of the models and simulations do <u>not</u> have current requirements for atmospheric data. But, when asked a follow-on question about **potential requirements**, 17 of the 30 respondents indicated that their model or simulation could use atmospheric data in the future.

To pursue more quantitative details, questions were posed about **specific requirements for atmospheric and near-space-environment data types**. For the atmospheric data types, **wind is noticeably the most dominant atmospheric data type—currently required by 33 of the 74 models and simulations,** increasing to over 50 if potential requirements are considered. Six other atmospheric data types (i.e., aerosols, clouds, fog, precipitation, temperature, and visibility) are currently required by 23 to 29 models and simulations. If potential requirements are again considered, the same six are required by a substantial additional number of models and simulations. Precipitation shows the largest increase for all 26 data types, including wind. For those 44 models and simulations currently requiring any of the 26 atmospheric data types, a general preference is expressed for 100-m and 10-km horizontal resolution data. For the vertical dimension, 100-m resolution data are generally preferred as a requirement. Atmospheric data resolved at one-hour intervals dominate the time resolution requirements for the 44 models and simulations.

Questionnaire respondents were also asked to identify **requirements for atmospheric effects** (i.e., the modeled or simulated effects that the atmosphere causes on the performance of military objects, such as forces, platforms, weapon systems, communication systems, and sensors). When the number of atmospheric effects requirements for each military object family (i.e., forces, platforms, weapon systems, communication systems, and sensors) were compared to the number of models and simulations including each military object family, **this survey's most striking and unexpected result** was found. Sixty percent (31 of 52) of the models and simulations including sensors were identified to have requirements for atmospheric effects on sensors, whereas 29 percent (10 of 34) of the models and simulations including communication systems were identified to have requirements for atmospheric effects on communication systems. However, **there is almost a complete lack of requirements for atmospheric effects on forces, platforms, and weapon systems. Just <u>one</u> model has been identified to have atmospheric effects requirements for forces, only 15 percent (7 of 47) of the models and simulations that incorporate platforms were identified to have atmospheric effects for platforms, and just 9 percent (4 of 46) models and simulations including weapon systems have requirements for atmospheric effects on weapon systems.**

For the **near space environment**, a paucity of models and simulations have been identified as having either current or potential requirements. Only 7 models and simulations surveyed have current requirements, increasing to 10 if potential requirements are included. For those few models and simulations having current requirements, the dominant data type of the 23 near-space-environment data types is "solar parameters" (i.e., solar position, solar radiative flux, sunspot activity, and solar index). When potential requirements are also considered, the solar parameters data type remains dominant. Three other data types (i.e., lunar parameters, radio background noise, and sudden ionospheric storms) follow solar parameters when both current and potential requirements are considered.

For those models having current requirements for near-space-environment data, only two time resolution requirements have been identified. These time interval requirements are 0.1 sec and 1.0 sec. Requirements for near-space-environment effects are also meager. Requirements for effects on platforms, communication systems, and sensors total only three.

A question was posed about requirements for **other types of environmental data**. Responses indicate that 20 of the models and simulations have some 43 requirements for ocean data. The number of requirements for terrain data is also substantial. Eighteen models and simulations have a total of 27 requirements for terrain data.

Other questions on technical aspects that might possibly be associated with the model or simulation were also posed. In terms of scalability, only 7 of 41 respondents indicated any **scalability requirements**. As for **compatibility requirements**, UNIX operating systems clearly dominate the set of 74 models and simulations surveyed. C, FORTRAN, Ada, and C++ dominate the programming language requirements. **Database management system requirements** were not plentiful, but those responding with requirements indicate that unique systems are preferred. Very few (only 10) models and simulations were identified to have near-term **software change requirements**.

Host hardware requirements are numerous in terms of the various types of hardware. While no clearly dominant hardware requirement exists, SGI, VAX, and SPARC hardware are required more than others. Most models and simulations have been identified to have transportability requirements by 39 of 52 responses to the question. For data media requirements, four types dominate: floppy disk, CD-ROM, 8-mm cartridge, and nine-track tape.

Twenty-five of 52 responses to the question on **data security requirements** indicated that environmental data could be classified to the Secret level, 15 responses indicated unclassified requirements, none indicated Confidential, and 7 indicated Top Secret. External **connectivity requirements** were about evenly split among none, ordinary phonelines with modems, encrypted phonelines, and other types of communications, such as a T-1 line.

Less than 30 percent of the models and simulations have **requirements for verified, validated, and accredited environmental data**. Barely a majority, 25 of 49 responses, indicated a requirement for environmental data that is reasonably current. For those 44 models and simulations planned for upgrades by FY-97, 52 percent (or 23) will be incorporating new atmospheric data types. Two of these 44 models are being planned for the incorporation of near space data.

The aggregated response to the final question in the Requirements Questionnaire was enlightening. About 60 percent of those responding to the question indicated that a **briefing** on atmospheric and near space data types, features, processes, and effects would be of interest.

6.2 CASE STUDY—THE WIND ATMOSPHERIC DATA TYPE

A case study on the wind atmospheric data type was prepared to examine the relationships and applications of this atmospheric data type in the models and simulations that have such a requirement. Both current and potential requirements were considered. The wind data type was selected for this case study since it is required by more models and simulations than any other atmospheric data type.

Interestingly, over 60 percent of the Research and Development models and simulations have requirements for the wind atmospheric data type, but **only 26 percent of the Analysis and 36 percent of the Military Operations models and simulations have wind data type requirements. A surprising and unexpected result is that none of the nine Campaign-level models and simulations require the wind atmospheric data type**, and only 44 percent of the Mission-level models and simulations do. Small increases occur for the Analysis and Campaign-level models and simulations if potential requirements for the wind atmospheric data type are included. But, the Mission-level models and simulations show a significant increase, 81 percent (almost doubling in number and totaling 13 of 16), when potential requirements are considered.

By segregating the models and simulations into simulation types (i.e., live, virtual, and constructive), another interesting, yet perplexing, result is found. **Five of the eight live play models and simulations do not have current or potential requirements for the wind atmospheric data type.** This finding is somewhat disconcerting from an intuitive standpoint and is discussed further in the Comments and Recommendations subsection.

A very strong relationship exists between those models and simulations having requirements for the wind atmospheric data type and those that have been identified to have critical environmental factors. All but one (32 of 33) of the models and simulations having current requirements for the wind atmospheric data type also have been identified to have critical environmental factors.

When a comparison is made between the total number of models and simulations having a specific family of military objects with the number of those same models having requirements for either atmospheric effects or the wind atmospheric data type, another interesting, yet, perplexing result materializes. **Models simulating forces, platforms, and weapon systems tend not to have any atmospheric effects requirements but tend to have requirements for the wind data type.** Again, this result is counterintuitive and is the topic of further discussion in Subsection 6.4.

In terms of resolution requirements, models and simulations having current requirements for the wind atmospheric data type match very closely with the resolution requirements aggregated for all of the atmospheric data types. That is, no uniqueness is associated with the horizontal, vertical, or time resolution requirements for the wind data type.

6.3 FINDINGS

Four significant findings that materialized during the course of conducting this Requirements Survey effort have been identified:

- Lists of the major M&S efforts in each Service were not available to the Survey Task Team at the start of the Requirements Survey.

- A need is evident for making the M&S community aware of the natural environment and its effects on military forces, platforms, weapon systems, sensors, and communication systems.

- A simple, conceptual diagram demonstrating the relationships of environmental effects, environmental impact, environmental models and databases, and warfighting models was not available; and, an authoritative set of definitions for environmental effects and environmental impact also was not available.

- Models and simulations have implicit, as well as explicit, requirements for environmental data.

To offset the deficiency cited by the first finding, the Survey Task Team periodically coordinated its list of questionnaire responses with the principal M&S offices of the Services. Regarding the second finding, the Survey Task Team learned early-on that for several interviews informal briefings were required to make the technical experts for the models and simulations aware of various types and aspects of environmental effects. The Survey Task Team developed a simple conceptual diagram and a set of definitions for environmental effects and environmental impact to fill the void mentioned in the third finding. Relevant to the final finding, explicit requirements have been focused on by this survey, as they typically are in most surveys. However, as a consequence of reviewing technical documentation for some of the models and simulations, the Survey Task Team found that environmental effects data and environmental data may also have implicit requirements. One example of implicit requirements for atmospheric effects and

atmospheric data was discovered when a Survey Task Team member reviewed algorithms for a theater-level warfighting model. Some of the warfighting model's algorithms included requirements for target detection ranges for ground-based air defense radars. Although no explicit requirements were found for atmospheric effects and atmospheric data for the radar target detection ranges, implicit requirements were found because the range of a radar is always dependent upon the effects of the atmosphere on propagating radar energy. Moreover, the state of the atmosphere that is affecting the propagating radar energy can be described by a set of atmospheric data types, such as air temperature, water vapor, and precipitation.

6.4 COMMENTS AND RECOMMENDATIONS

The analysis of aggregated data recorded on the 74 returned requirements questionnaires and the specific data analysis associated with the case study of one atmospheric data type, wind, provide quantitative results and insights for both the M&S community and the environmental science and support community of the Military Services. The qualitative findings of the Survey Task Team members appear to correlate closely with some of these quantitative results to strongly suggest that **a pervasive need exists for the M&S community and the environmental science and support community to establish a continuing dialogue and interaction to identify and clarify requirements for incorporating atmospheric and near-space-environment data and effects into military warfighting models and simulations.**

6.4.1 Issues Recommended for Further Research

Besides the need for a general dialogue, the results of this Requirements Survey effort also point to some specific issues that are recommended for further research to assist both communities in discussing potential areas to improve the realism of military models and simulations. The following questions originate from the results of the Analysis and Case Study sections and from a finding in the Findings Section and are recommended for further investigation:

1. Why do only 60 percent of the Military Operations models and simulations have critical environmental factors?

2. Why are so few requirements for atmospheric effects for forces, platforms, and weapon systems in the military models and simulations surveyed?

3. Why are so few requirements identified for near-space-environment data?

4. Why do only 26 percent of the Analysis models and simulations surveyed have requirements for the wind atmospheric data type?

5. Why do none of the Campaign-level models and simulations have requirements for the wind atmospheric data type?

6. Why do five of eight live play simulations have no requirements for the wind atmospheric data type?

7. Why do a majority of constructive and virtual models and simulations have requirements for the wind atmospheric data type but do not have requirements for the effects of the wind?

8. What is the importance of implicit requirements in military models and simulations?

6.4.2 Issues Recommended for Resolution

In Section 5, other key issues are identified and discussed. The Survey Task Team recommends that these issues be acted upon as follows:

1. A list of major models and simulations for each of the Military Services could be beneficial, but, currently, such a list does not exist for any of the Services. It is recommended that the DMSO and the Services investigate ways to correct this shortfall.

2. Using the Survey Task Team's simple conceptual diagram as a starting point, the Services' M&S and environmental science and support communities should mutually develop a conceptual model that incorporates environmental effects, environmental impact, environmental models, and environmental databases that support warfighting models. Such a conceptual model could also assist the military M&S community further by being the basis for developing roadmaps that guide the integration of environmental effects and environmental data into models and simulations.

3. Taking the Survey Task Team's definitions for environmental effects and environmental impact, the Services' M&S and environmental science and support communities should

mutually agree to their applicability and include these definitions in appropriate glossaries and data dictionaries.

4. To assist the military M&S community, the environmental science and support community should develop a handbook of environmental effects and environmental impact applicable to warfighting models and simulations. This handbook should include examples of both explicit and implicit requirements for environmental effects, environmental impact, and environmental data.

5. A need exists for a consistent, institutional approach in identifying requirements for atmospheric and near-space-environment effects and data for modeling and simulation. One method might be to associate an "environmental sensitivity descriptor" with each object in the military model or simulation. It is recommended that the DMSO and the Military Services consider such a descriptor and develop an institutional approach for identifying atmospheric and near-space-environment effects and data requirements for the military M&S efforts.

6.4.3 Feedback Briefing

The magnitude of the positive response to the final question in the Requirements Questionnaire (related to receiving a briefing on atmospheric and near-space-environment data types effects, processes, and features) indicates a need for a concerted effort to provide such a briefing. About 60 percent of those responding to the question desire a briefing. It is recommended that the Military Services' environmental science and support community provide this briefing to those questionnaire respondents who indicated an interest.

The results, findings, and recommendations summarized in this section were gleaned from the current requirements survey effort. Complementary efforts of the Survey Task are (1) cataloging existing models and databases that characterize specific representations and effects of the atmosphere and near space environment; and (2) assessing the capabilities of those cataloged representations with the requirements identified in this document, which are expected to produce additional results, findings, and recommendations. These efforts will be documented in two separate reports.

REFERENCES

Burgeson, J.C., T.M. Piwowar, P.D. Try, D.D. Grantham, S. Brand, and A.E. Wetmore, 1996a: *Natural Environmental Effects in Military Models and Simulations: Part II—A Survey of Capabilities.* Technical Report PL-TR-96-2040, U.S. Air Force Phillips Laboratory, Hanscom Air Force Base, Massachusetts.

Burgeson, J.C., T.M. Piwowar, P.D. Try, D.D. Grantham, S. Brand, and A.E. Wetmore, 1996b: *Natural Environmental Effects in Military Models and Simulations: Part III—A Analysis of Requirements Versus Capabilities.* Technical Report PL-TR-96-2039, Air Force Phillips Laboratory, Hanscom Air Force Base, Massachusetts.

Defense Mapping Agency, 1993: *Modeling and Simulation Requirements Database.* Summary Report, DMA, Reston, Virginia.

Distributed Interactive Simulation Atmosphere Subgroup (no date): Distributed Interactive Simulation (DIS) Atmosphere and Near Space Environmental Representation Rationale. Draft, 9 September 1994, Orlando, Florida.

Heckathorn, H., 1994: Environmental Effects for Distributed Interactive Simulation (E^2DIS). *Proceedings, 1994 Meeting of the IRIS Specialty Group on Targets, Backgrounds and Discrimination,* Infrared Imagery Society, Monterey, California.

Naval Research Laboratory, 1994: *E^2DIS Project Development Plan, Revised, 9 November 1994.* E^2DIS Program Office, NRL, Washington, DC.

Naval Research Laboratory, 1995: *E^2DIS Program Requirements.* E^2DIS Program Office, NRL, Washington, DC, April 1995.

Siquig, R.A., B.G. Shapiro, and M. Miller, 1995: A Master Environmental Library to Support Modeling and Simulation. PL-TR-95-2129, Preprint, *Cloud Impacts on DoD Operations and Systems 1995 Conference (CIDOS-95),* Hanscom Air Force Base, Massachusetts, 1 October 1995, pp. 21–22, ADA300914.

The Institute for Simulation & Training, 1995: *The 13th DIS Workshop on Standards for the Interoperability of Distributed Simulations, September 18–22, 1995*. University of Central Florida, Orlando, Florida.

Under Secretary of Defense for Acquisition and Technology, 1995: *Modeling and Simulation (M&S) Master Plan*. DoD 5000.59-P, Department of Defense, Washington, DC.

APPENDIX A

REQUIREMENTS QUESTIONNAIRE

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Administrative Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

A. **Administrative Information**

1. Simulation or Model Title: _____
   _____

2. General Description of the Simulation or Model's Purpose:
   (Alternatively, attach a one or two-page existing description)
   _____
   _____
   _____
   _____
   _____
   _____

3. Technical Expert for the Above Simulation or Model

   a. Rank/Title, Name, Service: _____
   b. Organization Title and Mailing Address:
   _____
   _____
   _____
   _____
   _____

   c. Phone Numbers
   (1) Office: DSN _____ - _____
   Commercial ( ) _____ - _____
   (2) Fax: DSN _____ - _____
   Commercial ( ) _____ - _____

   d. E-mail Address: _____

4. Service / Organization having Primary Responsibility for the Simulation or Model: (Circle One)

   a. Army b. Navy c. Marine Corps d. Air Force e. Other (Explain) _____

5. Organizational Location(s) of the Simulation or Model: _____
   _____
   _____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

B. **Technical Information**

1. **Critical Factors.**

   a. What are the most critical factors, or issues, regarding the atmosphere and near space environment that have to be considered for your simulation or model?

_____
_____
_____
_____
_____

   b. Where are these critical factors documented? (e.g., identify applicable Mission Needs Statement, Statement of Need, Operational Requirement Document, etc.) _____
_____
_____

2. **Status** of the Simulation or Modeling Effort (Circle One and Fill-in the appropriate Blank(s))

   a. "Operational" today; frequency of use is: _____times per day ____ times per week ____ per month
   b. Not "operational" today, but will be "operational" by FY-97
   c. None of the above (Explain status: _____)

3. **Application** of the Simulation or Modeling Effort

   a. Use in Distributed Interactive Simulation (DIS) (Circle One)

      (1) Used in DIS today
      (2) Not used in DIS today, but planned for DIS use by FY-97
      (3) Not used in DIS today, and no plan to use in DIS before FY-97
      (4) None of the Above (Explain: _____)

   b. This Simulation or Model is used for the following types of simulations:

      (Circle All that Apply. Underline the Predominant Use.)

      (1) Constructive—Typically, classroom-setting simulations of large-scale (e.g., theater-wide) military activities.
      (2) Virtual—Forces, platforms, weapon systems and sensors modeled in simulators and fighting on synthetic battlefields depicted by these simulators.
      (3) Live Play—Simulations using real-world forces and equipment in the field.

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

3. **Application** of the Simulation or Model [Continued]

c. Simulation or Model's Functional Use
(Circle All that Apply. Underline the One Predominant Category)

(1) Education and Training
(2) Research and Development (includes Design & Engineering)
(3) Test and Evaluation (includes both DT&E and OT&E)
(4) Analysis
(5) Production & Logistics
(6) Military Operations (includes Mission Planning and Mission Rehearsal)

d. This Simulation or Model is Primarily Used for which Hierarchical Category(ies)?
(Circle All that Apply. Underline the One Predominant Category)

(1) Campaign Level (Echelon Above Corps)
(2) Mission Level (Corps/Division)
(3) Many-on-Many to Few-on-Few Level (Combined Arms Task Force)
(4) One-on-One Level (Weapons System)
(5) Engineering Level (Weapon Subsystem Characteristics)
(6) None of the Above (Explain: _____)

e. Types of Applications Supported: (Circle as Many as Apply. Underline the Predominant One)

(1) Sensor Acquisition of Targets
(2) Mobility of Platforms/Forces
(3) Decision Aids for Command & Control Authority
(4) Other (Explain): _____
_____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

3. **Application** of the Simulation or Model [Continued]

f. Identify Missions, Forces, Platforms, Weapon Systems, Communications Systems, Sensors & Targets Being Simulated or Modeled: (Attach additional pages, if necessary)

(1) Missions: _____
_____
_____
(2) Forces: _____
_____
_____
(3) Platforms: _____
_____
_____
(4) Weapons Systems: _____
_____
_____
(5) Communications Systems: _____
_____
_____
(6) Sensors:
(a) Active: _____
(b) Passive: _____
(7) Targets: _____
_____

g. List the most authoritative reference document(s) for the Simulation or Model.

_____
_____
_____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

4. Simulation or Model's **Domains**

a. **Horizontal Surface** Domain (Circle All that Apply and Underline the Predominant One)

(1) Global (All Landmasses and All Oceans/Seas)
(2) Global Land (All Landmasses, including Adjacent Waters)
(3) Global Ocean (All Ocean Areas, including Adjacent Coastlines)
(4) Regional Land (Specific Land Regions, including Adjacent Waters. e.g., western U.S. Provide a List of the Regions)
(5) Regional Ocean (Specific Ocean Regions, including Adjacent Coastlines. e.g., eastern North Pacific. Provide a List of the Regions)
(6) Littoral (Typically, Regional Land Areas within 650 n.mi. of coastline and Regional Ocean Areas as far seaward as required. Provide a List.)
(7) Local Land (Very Specific Land Areas, including Adjacent Waters. e.g., Fort Irwin, CA. Provide a List)
(8) Local Ocean (Very Specific Ocean Areas, including Adjacent Coastlines. e.g., Southern California OPAREA. Provide a List)
(9) Other (Explain: _____)

b. **Vertical** Domain (Circle All that Apply and Underline the Predominant One; Indicate the Required, Specific Ranges where Requested)

(1) Land Surface
(2) Land Subsurface Required Range: Depths of _____ km to _____km
(3) Ocean Surface
(4) Ocean Subsurface Required Range: Depths of _____ km to _____km
(5) Atmosphere
  (a) Near-Earth (Surface to 1 km altitude) Required, specific altitude range is: _____ km to _____ km
  (b) Atmosphere (1 km to 300 km altitude) Required, specific altitude range is: _____ km to _____ km
(6) Near Space (300 km to 70,000 km altitude) Required, specific altitude range is: _____ km to _____ km
(7) Other (Explain: _____)

c. **Time** Domain (Fill-in the Blank and Circle the Appropriate Units of Measure)

(1) The time period that is typically being simulated is:
_____ minutes hours days weeks months

(2) The maximum time period that can be simulated is:
_____ minutes hours days weeks months

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

5. Simulation or Model's **Current Requirements** -- Requirements that have to be satisfied **Today**

   a. **Grid**

      (1) What type grid does the simulation or model typically use today? _____
      _____
      (2) What type map projection does the simulation or model typically use today? _____
      (3) What other grid(s) and projection(s) can the simulation or model use? _____
      _____

   b. Today, this Simulation or Model includes the following **types of environmental data and effects**:
      (Circle All that Apply, and Complete the Appropriate Attachments)

      (1) Atmospheric Data and Effects—Use Attachment 1
      (Surface to 300 km altitude)

      (2) Near Space Data and Effects—Use Attachment 2
      (300 km to 70,000 km altitude)

      (3) Other Data and Effects (Identify any other types of environmental data and environmental effects that are required for model runs; e.g., terrain or ocean parameters, features, processes, and effects)

      _____
      _____
      _____

   c. Other Technical Requirements. For each environmental data type and effect that you cite in Attachments 1 and 2, please complete Attachment 3, which describes the following technical requirements:

      (1) Fidelity Requirements
      (2) Scalability Requirements
      (3) Compatibility Requirements
      (4) Accessibility Requirements
      (5) VV & A Requirements
      (6) Currency Requirements

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

6. Simulation or Model's **Future Requirements**—Requirements that will have to be satisfied when an upgrade to the Simulation or Model is implemented sometime in the **Future**

   a. Will this Simulation or Model be upgraded by FY-97? (Circle one)

      (1) Yes (If Yes, proceed to the next question, 6. b.)
      (2) No (If No, proceed to question 6. c.)

   b. Briefly, explain the reason(s) for this upgrade. _____

_____

_____

(1) **Changes resulting from the upgrade.**

(a) List those "current requirements" for environmental data and effects, identified in your responses to 5. a., b. & c. above, that will change as a result of the upgrade; and, briefly describe how these requirements will change quantitatively?

_____

_____

_____

_____

_____

(b) Why are you changing your requirements for environmental data and effects?

_____

_____

(2) **New requirements.**

(a) List any new environmental data and effects required as a result of the planned upgrade:

_____

_____

_____

_____

(b) Why are you requiring new environmental data and effects?

_____

_____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Technical Information

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

6. Simulation or Model's **Future Requirements**—Requirements that will have to be satisfied when an upgrade to the Simulation or Model is implemented sometime in the **Future**
[Continued]

   c. **Potential Value**. If there are no plans for an upgrade, would an upgrade be considered if environmental data and resulting environmental effects could be reliably provided? (Circle one and Fill-in the Blank)

      (1) Yes, for the following reason(s): _____
      _____

      (2) No, for the following reason(s): _____
      _____

7. **Briefing**. Would a briefing on atmospheric and near space parameters, features, processes and effects be of interest to you for your simulation efforts? (Circle one) Yes No

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

A. Simulation or Model Title: _____ (Fill-in the Blank)

B. Vertical Domain: **Atmosphere** (Including the Near-Earth Atmosphere; i.e., Surface to 300 km altitude)

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
1. Aerosols a. Cloud b. Haze c. Blowing Dust d. Volcanic Dust e. Smog	a. ___ b. ___ c. ___ d. ___ e. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. ___
2. Atmospheric Electricity a. Lightning b. Local Electric Field Potential	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
3. Clouds a. % Sky Coverage b. Liquid Water c. Particle Size d. Bases/Tops e. Types (1) High (2) Medium (3) Low (4) Other (Specify)	a. ___ b. ___ c. ___ d. ___ e. (1) ___ (2) ___ (3) ___ (4) ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. (1) ___ (2) ___ (3) ___ (4) ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
4. Dew Point	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
5. Fog	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
6. Humidity a. Absolute b. Relative	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
7. Mixing Ratio	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
8. Precipitation a. Rate b. Type (1) Rain (2) Freezing Rain (3) Graupel (4) Hail (5) Sleet (6) Snow	a. ___ b. (1) ___ (2) ___ (3) ___ (4) ___ (5) ___ (6) ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. (1) ___ (2) ___ (3) ___ (4) ___ (5) ___ (6) ___
9. Refractivity	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
10. Sea Level Pressure	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
11. Static Stability	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
12. Temperature a. Atmosphere b. Surface–Land c. Surface–Ocean	a. ___ b. ___ c. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___
13. Trace Gases	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
14. Transmissivity	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
15. Visibility a. Horizontal b. Slant Range	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
16. Winds–General a. Horizontal b. Vertical	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
17. Winds–Specific Features a. Fronts b. Gust Fronts c. Hurricanes/ Typhoons d. Thunderstorms e. Tornados/ Waterspouts f. Turbulence g. Wind Shear	a. ___ b. ___ c. ___ d. ___ e. ___ f. ___ g. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. ___ f. ___ g. ___
18. Radiative Features a. Sky Brightness b. Predetermined Natural Illumination Sources (e.g., particle emissitivity) c. Local Albedo (from e.g., soil, snow cover) d. Cloud Radiance	a. ___ b. ___ c. ___ d. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
19. Smoke a. Naturally caused b. Human-generated	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
20. Chaff Dispersion	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
21. Combat-generated Dust -- Development and Dispersion	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
22. Contrail Formation and Dispersion	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
23. Dispersal of a. Biological Agents b. Chemical Agents c. Flares d. Exhaust Plumes from Terrain Vehicles e. Industrial Smoke Plumes	a. ___ b. ___ c. ___ d. ___ e. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. ___
24. Non-Nuclear Munitions Effects a. Explosive Shock-Induced Water Droplet Clouds b. Fireball Temperature	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
25. Nuclear Weapons Detonation Effects a. Enhanced Radiance b. Dispersal of X-rays and Nuclear Particles c. Movement of Shock Waves d. Winds e. Elevated Temperatures	a. ___ b. ___ c. ___ d. ___ e. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Atmospheric Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Atmospheric Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
26. Ship Exhaust Tracks (i.e., Dispersal of stack exhaust; ship wakes are not included here, since they are an ocean-embedded process)	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Atmospheric Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

1. Sensor Systems

a. Name of Sensor System:		
b. Energy Type (Specify frequency, wavelength bands or other standard units of measure)	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Particle Radiation _____ (4) Other: (Specify Type and Frequency Band) _____	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Particle Radiation _____ (4) Other: (Specify Type and Frequency Band) _____
c. Type of Sensor	(1) Active (2) Passive	(1) Active (2) Passive
d. Environmental Effects Required	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____
e. What Line-of-Sight sensor-target geometries are required?	(1) Nadir / Near-nadir (2) Limb / Near-limb (3) Zenith / Near-zenith (4) Other: (Provide azimuth and bearings from sensor) _____	(1) Nadir / Near-nadir (2) Limb / Near-limb (3) Zenith / Near-zenith (4) Other: (Provide azimuth and bearings from sensor) _____
f. Altitude requirements for sensor and target:	(1) Sensor altitude range is: _____ km to _____ km. (2) Target altitude range is: _____ km to _____ km.	(1) Sensor altitude range is: _____ km to _____ km. (2) Target altitude range is: _____ km to _____ km.
g. General state of the environment required:	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorally-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorally-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Atmospheric Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

[Continued]

2. Communications Systems

a. Name of Communications System:		
b. Energy Type (Specify frequency, wavelength bands or other standard units of measure)	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Other: (Specify Type and Frequency Band) _____	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Other: (Specify Type and Frequency Band) _____
c. Environmental Effects Required	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____
d. What type of transmitter-receiver geometries are required?	(1) Line-of-Sight (2) Over-the-Horizon (a) Upper limit of altitude for energy path is: _____ km. (b) Horizontal limit for energy path is: _____ km. (3) Other: (Describe) _____	(1) Line-of-Sight (2) Over-the-Horizon (a) Upper limit of altitude for energy path is: _____ km. (b) Horizontal limit for energy path is: _____ km. (3) Other: (Describe) _____
e. Altitude requirements for transmitter and receiver:	(1) Transmitter altitude range is: _____ km to _____ km. (2) Receiver altitude range is: _____ km to _____ km.	(1) Transmitter altitude range is: _____ km to _____ km. (2) Receiver altitude range is: _____ km to _____ km.
f. General state of the environment required:	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorally-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorally-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____

E^{2}DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 1: Atmospheric Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Atmospheric Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

[Continued]

3. Weapon Systems

a. Name of Weapon System:		
b. Required atmospheric effect(s) on the performance of the weapon system (e.g., deflection of projectiles/ ordnance ballistic trajectories due to wind):	Provide List:	Provide List:

4. Platforms

a. Name of Platform:		
b. Required atmospheric effect(s) on the performance of the platform (e.g., ice accretion on aircraft, ships, terrain vehicles):	Provide List:	Provide List:

5. Forces

a. Type / Name of Force:		
b. Required atmospheric effect(s) on the performance of the force (e.g., temperature effects on work-load performance / combat efficiency):	Provide List:	Provide List:

6. Other

a. Type / Name of Object:		
b. Required atmospheric effect(s) on the performance of the object:	Provide List:	Provide List:

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

A. Simulation or Model Title: _____ (Fill-in the Blank)

B. Vertical Domain: **Near Space** (300 km to 70,000 km altitude)

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
1. Auroral Particle Precipitation (i.e., Energy Flux)	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
2. Cosmic Rays	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
3. Diffuse Zodiacal Emission a. Infra-red b. Visible	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
4. Geomagnetic Field a. Strength b. Indices	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
5. Interplanetary Medium		• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	
a. Interplanetary Magnetic Field	a. ___		a. ___
(1) Strength	(1) ___		(1) ___
(2) Orientation	(2) ___		(2) ___
b. Solar Wind	b. ___		b. ___
(1) Velocity	(1) ___		(1) ___
(2) Density	(2) ___		(2) ___
(3) Temperature	(3) ___		(3) ___
c. Magnetopause Standoff Distance	c. ___		c. ___
6. Low Energy Plasma Environment		• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	
a. Ions	a. ___		a. ___
(1) Composition	(1) ___		(1) ___
(2) Number Density	(2) ___		(2) ___
(3) Avg. Velocity	(3) ___		(3) ___
(4) Temperature	(4) ___		(4) ___
(5) Flux	(5) ___		(5) ___
b. Electrons	b. ___		b. ___
(1) Number Density	(1) ___		(1) ___
(2) Vertical Profiles	(2) ___		(2) ___
(3) Total Electron Content	(3) ___		(3) ___
(4) Avg. Velocity	(4) ___		(4) ___
(5) Temperature	(5) ___		(5) ___
(6) Flux	(6) ___		(6) ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
7. Lunar Parameters a. Lunar Brightness b. Lunar Position	a. ___ b. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___
8. Meteoroids and Debris a. Mass b. Diameter c. Density d. Flux e. Impact Flux Size Distribution	a. ___ b. ___ c. ___ d. ___ e. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___ e. ___
9. Neutral Environment a. Composition b. Density c. Temperature d. Winds	a. ___ b. ___ c. ___ d. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___
10. Radio Background Noise	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
11. Solar Parameters a. Solar Position b. Solar Radiative Flux c. Sunspot Activity d. Solar Index	a. ___ b. ___ c. ___ d. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___
12. Star and Planetary Positions	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
13. Energetic Particles a. Particle Type b. Energy c. Flux d. Spatial and Temporal Distribution	a. ___ b. ___ c. ___ d. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___
14. Geomagnetic Storms a. Magnetosphere b. Aurora c. Radiation Belts d. Spatial and Temporal Distribution	a. ___ b. ___ c. ___ d. ___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	a. ___ b. ___ c. ___ d. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
15. Gravity Waves	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
16. Noctilucent Clouds	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
17. Polar Cap Absorption	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
18. Sporadic E	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
19. Sudden Ionospheric Storms	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
20. Dispersal of Flares	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
21. Formation and Dispersal of Rocket Exhaust	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___
22. Munitions Effects (Nonnuclear)	___	• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

C. **Requirements** for **Near Space Data**: (Check All that Apply in the Appropriate Column, and Indicate the Simulation or Model's Source(s) for Each Data Type)

[Continued]

Near Space Data Type	Simulation or Model Currently Uses This Data Type (Place an "X" where Applicable and Indicate Source(s) of Data)	Fidelity Requirements for This Data Type (Fill-in the Blanks only if Column 2 is "X'd")	Simulation or Model Has the Potential to Use This Data Type (Place an "X" where Applicable)
23. Nuclear Weapons Detonation Effects		• Horizontal Grid Spacing: _____ m. • Vertical Grid Spacing: _____ m. • Time Resolution: _____ sec. • Units of Measure for Data Type: _____ •• Required Range: Min. = _____ Max. = _____ •• Required Accuracy: _____	
a. Elevated Temperatures	a. ___		a. ___
b. Enhanced Radiance	b. ___		b. ___
c. Dispersal of X-rays and nuclear particles	c. ___		c. ___
d. Movement of Shock Wave	d. ___		d. ___
e. Nuclear Heave	e. ___		e. ___
f. Winds	f. ___		f. ___

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Near Space Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

1. Sensor Systems

a. Name of Sensor System:		
b. Energy Type (Specify frequency, wavelength bands or other standard units of measure)	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Particle Radiation _____ (4) Other: (Specify Type and Frequency Band) _____	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Particle Radiation _____ (4) Other: (Specify Type and Frequency Band) _____
c. Type of Sensor	(1) Active (2) Passive	(1) Active (2) Passive
d. Environmental Effects Required	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____
e. What Line-of-Sight sensor-target geometries are required?	(1) Nadir / Near-nadir (2) Limb / Near-limb (3) Zenith / Near-zenith (4) Other: (Provide azimuth and bearings from sensor) _____	(1) Nadir / Near-nadir (2) Limb / Near-limb (3) Zenith / Near-zenith (4) Other: (Provide azimuth and bearings from sensor) _____
f. Altitude requirements for sensor and target:	(1) Sensor altitude range is: _____ km to _____ km. (2) Target altitude range is: _____ km to _____ km.	(1) Sensor altitude range is: _____ km to _____ km. (2) Target altitude range is: _____ km to _____ km.
g. General state of the environment required:	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorially-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorially-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Near Space Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

[Continued]

2. Communications Systems

a. Name of Communications System:		
b. Energy Type (Specify frequency, wavelength bands or other standard units of measure)	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Other: (Specify Type and Frequency Band) _____	(1) Acoustic _____ (2) Electromagnetic Radiation _____ (3) Other: (Specify Type and Frequency Band) _____
c. Environmental Effects Required	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____	(1) Absorption (5) Refraction (2) Ducting (6) Scattering (3) Emission (7) Transmission (4) Reflection (8) Other: (Specify) _____
d. What type of transmitter-receiver geometries are required?	(1) Line-of-Sight (2) Over-the-Horizon (a) Upper limit of altitude for energy path is: _____ km. (b) Horizontal limit for energy path is: _____ km. (3) Other: (Describe) _____	(1) Line-of-Sight (2) Over-the-Horizon (a) Upper limit of altitude for energy path is: _____ km. (b) Horizontal limit for energy path is: _____ km. (3) Other: (Describe) _____
e. Altitude requirements for transmitter and receiver:	(1) Transmitter altitude range is: _____ km to _____ km. (2) Receiver altitude range is: _____ km to _____ km.	(1) Transmitter altitude range is: _____ km to _____ km. (2) Receiver altitude range is: _____ km to _____ km.
f. General state of the environment required:	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorally-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____	(1) Quiescent conditions (a) Day (b) Night (c) Terminator (2) Disturbed conditions (a) Aurorially-Disturbed (b) Nuclear-Disturbed (c) Other (Specify): _____

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Near Space Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

[Continued]

3. Weapon Systems

a. Name of Weapon System:		
b. Required near space effect(s) on the performance of the weapon system:	Provide List:	Provide List:

4. Platforms

a. Name of Platform:		
b. Required near space effect(s) on the performance of the platform (e.g., drag effects on satellites):	Provide List:	Provide List:

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 2: Near Space Data and Effects

[Complete all items. Use "N/A" if not applicable, or a "?" if unknown.]

D. **Requirements** for **Near Space Effects**: (Circle All that Apply, and Fill-in the Appropriate Blanks)

[Continued]

5. Forces

a. Type / Name of Force:		
b. Required near space effect(s) on the performance of the force (e.g., zero gravity effects on work-load performance/combat efficiency):	Provide List:	Provide List:

6. Other

a. Type / Name of Object:		
b. Required near space effect(s) on the performance of the object:	Provide List:	Provide List:

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 3: Other Requirements

[Complete all items. Use "N/A" if not applicable, or a "?" unknown.]

A. Simulation or Model Title: _____ (Fill-in the Blank)

B. Type(s) of Environmental Data / Effects:

(Circle below all the enviromental data types, identified in the responses to Attachments 1 & 2, that have the same fidelity requirements. Grouping is encouraged to minimize the number of Attachment 3's to be completed. Duplicate this attachment as necessary to characterize all grouped data types / effects.)

1. **Atmospheric** Data / Effects -- Attachment 1: C. 1., 2., 3., 4., 5., 6., 7., 8., 9., 10., 11., 12., 13., 14., 15., 16., 17., 18., 19., 20., 21., 22., 23., 24., 25., 26.
   D. 1., 2., 3., 4., 5., 6.

2. **Near Space** Data / Effects -- Attachment 2: C. 1., 2., 3., 4., 5., 6., 7., 8., 9., 10., 11., 12., 13., 14., 15., 16., 17., 18., 19., 20., 21., 22., 23.
   D. 1., 2., 3., 4., 5., 6.

C. **Other Requirements**:

1. Scalability Requirements

   a. Do the Simulation or Model's spatial grid and time interval have scaling requirements from the baseline fidelity requirements identified in Attachments 1 and 2 ?
   (Circle the Appropriate Answer) Yes No

   b. If No, proceed to the next question (2. Compatibility Requirements).

   If Yes,
   (1) Briefly, explain what grid and time interval scaling is possible: _____
   _____
   _____
   (2) Identify any scaling requirements for each environmental data type: _____
   _____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 3: Other Requirements

[Complete all items. Use "N/A" if not applicable, or a "?" unknown.]

C. **Other Requirements:**

[Continued]

2. Compatibility Requirements

a. Software

(1) Operating System. What operating system software is used to run this Simulation or Model?

_____

(2) Programming Languages. What programming languages are used ?

_____

(3) Database Management System. What database management system is used ?

_____

(4) Near-term Changes. Will any of these three types of software requirements change by FY-97?
(Circle the Appropriate Answer) Yes No

(a) If Yes, please identify the specific changes: _____

_____

_____

_____

(b) If No, proceed to the next question.

b. Hardware

(1) What host hardware system is currently used to run the Simulation or Model? _____

_____

(2) Is the host hardware system transportable?
(Circle the Appropiate Answer) Yes No

(3) What type(s) of data media can the system accept?
(Circle All that Apply)

(a) 9-track Tape
(b) Floppy Disk
(c) CD-ROM
(d) VLDS
(e) 8mm Cartridge
(f) WORM (Specify size)
(g) Floppy Disk
(h) Optical Tape
(i) Video Disk
(j) Other: (Specify)_____

E²DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 3: Other Requirements

[Complete all items. Use "N/A" if not applicable, or a "?" unknown.]

C. **Other Requirements**:

[Continued]

3. Accessibility Requirements

a. Security. What is the maximum information security level of the environmental data authorized for use by the Simulation or Model? (Circle the Appropriate Answer)

(1) Unclassified
(2) Confidential
(3) Secret
(4) Top Secret
(5) Other—Explain in unclassified terms: _____

_____

_____

b. Connectivity. What methods of external communications are authorized for use to input data? (Circle as Many as Apply)

(1) None
(2) Unclassified telephone (with modem) dial-up line.
(3) Encrypted telephone (with modem) dial-up line.
(4) Other—Explain briefly: _____

_____

4. VV&A Requirements

a. Verification. Do the atmospheric and near space databases, currently being used by this Simulation or Model, have to be "verified" ?

(Circle One) Yes No

(1) If Yes, to what level of detail do you require? _____

_____

_____

b. Validation. Do the atmospheric and near space databases, currently being used by this Simulation or Model, have to be "validated" ?

(Circle One) Yes No

(1) If Yes, to what level of detail do you require? _____

_____

_____

E^{2}DIS Project
Modeling & Simulation (M & S)
Requirements
Questionnaire

Attachment 3: Other Requirements

[Complete all items. Use "N/A" if not applicable, or a "?" unknown.]

C. **Other Requirements**:

4. VV&A Requirements

[Continued]

c. Accreditation. Do the atmospheric and near space databases, currently being used by this Simulation or Model, have to be "accredited" ?
(Circle One) Yes No

(1) If Yes, to what level of detail do you require? _____
_____
_____

5. Currency Requirements

a. Do the atmospheric and near space databases used by this Simulation or Model have to be based on, or derived from, reasonably current real-world data? (Circle One)

(1) Yes. Briefly explain: _____
_____
_____

(2) No. There is no specific currency requirement.

APPENDIX B

SERVICE LETTERS

DEPARTMENT OF THE ARMY
HEADQUARTERS UNITED STATES ARMY TRAINING AND DOCTRINE COMMAND
FORT MONROE, VIRGINIA 23651-5000

REPLY TO
ATTENTION OF

ATAN-SM 31 MAY 1994

MEMORANDUM FOR SEE DISTRIBUTION

SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

1. Request you assist the multi-service E2 DIS Project in conducting a survey of your organization. This survey is being conducted in cooperation with the Army Modeling and Simulation Management Office in support of the Defense Modeling and Simulation Management Office. Your assistance is requested to accomplish the following:

a. Identify all major modeling and simulation (M&S) efforts that are routinely used within your organization, and those major M&S efforts currently in development.

b. Specify a single point of contact, who is technically versed, for each M&S effort.

c. Provide the above information to Science and Technology Corporation by 30 June 1994. Forward your response either via mail or facsimile to the following:

Science and Technology Corporation
ATTN: Tom Piwowar
409 Third Street, S.W.
Suite 203
Washington, D.C. 20024

Facsimile: (202) 488-5364
Phone: (202) 863-0012

2. E2DIS Project background information and a summary of the Survey Task is provided at Enclosure 1. Information on how the survey will be conducted and a copy of the Requirements Questionnaire is at Enclosure 2.

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

3. Distribution of the results of this survey effort, in the form of the products listed in Enclosure 1 will be made to all survey respondents once the survey data is compiled and analyzed.

2 Encls

William J. Macpherson Jr.
WILLIAM J. MACPHERSON, JR.
Colonel, GS
Assistant Deputy Chief of
Staff for Analysis

DISTRIBUTION:
DEPUTY CHIEF OF STAFF FOR LOGISTICS, ATTN: DALO-PLZ-A, RM 2C567, 500 ARMY PENTAGON, WASHINGTON, DC 20310
DEPUTY CHIEF, ARMY RESERVE, ATTN: DAAR-ZB, RM 3E390, 2400 ARMY PENTAGON, WASHINGTON, DC 20310-2400
OFFICE OF THE CHIEF OF ENGINEERS, ATTN: DAEN-ZCM, RM 1E668, 2600 ARMY PENTAGON, WASHINGTON, DC 20310-2600
CHIEF, TRAINING DIVISION, NATIONAL GUARD BUREAU, ATTN: NGB-AROT, 111 SOUTH GEORGE MASON DRIVE, ARLINGTON, VA 22204-1382
U.S. ARMY SPACE COMMAND, ATTN: MOSC-OPI, 1670 NORTH NEWPORT ROAD, COLORADO SPRINGS, CO 80916-2749
DEP CINC, HQ USAREUR & SEVENTH ARMY, APO AE 09014
CDR, USA FORSCOM, ATTN: FCJ3-TSD, FORT MCPHERSON, GA 30330-6000
CDR, USA FORSCOM, ATTN: FCJ8-PBO, FORT MCPHERSON, GA 30330-6000
EIGHTH U.S. ARMY, ATTN: EACJ-ED, APO AP 96204
CDR, USA PACIFIC, ATTN: APRM-MC, FORT SHAFFTER, HI 96858-5100
CDR, USA SOUTH, ATTN: SOCS, APO MIAMI, FL 34004-5000
CDR, USA SPECIAL OPERATIONS COMMAND, ATTN: AOFI- CPC, FORT BRAGG, NC 28307-5200
CDR, USA SPACE AND STRATEGIC DEFENSE COMMAND, ATTN: CSSD-CR, P.O.BOX 1500, HUNTSVILLE, AB 35807
CDR, USAAMC, ATTN: AMCRD, 5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333-0001
CDR, USA OPERATIONAL TEST AND EVALUATION COMMAND, ATTN: CSTE-ZA, 4501 FORD AVENUE, ALEXANDRIA, VA 22302-1458
(CONT)

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

DISTRIBUTION: (CONT)
TECHNICAL DIRECTOR, AMC USATECOM, ATTN: AMSTE-TD, ABERDEEN PROVING GROUND, MD 21005-5055
CDR, USASTRICOM, ATTN: AMSTI-CG, 12350 RESEARCH PARKWAY, ORLANDO, FL 32826
CDR, USA ARMAMENT, MUNITIONS AND CHEMICAL COMMAND, ROCK ISLAND, IL, 61299-6000
CDR, USA AVIATION AND TROOP COMMAND, 4300 GOODFELLOW BOULEVARD, ST. LOUIS, MO 63120-1798
CDR, USA COMMUNICATIONS-ELECTRONICS COMMAND, FORT MONMOUTH, NJ 07703-5000
CDR, USA MISSILE COMMAND, REDSTONE ARSENAL, AL 35898-5000
CDR, USA TANK-AUTOMOTIVE COMMAND, WARREN, MI 48397-5000
USA TEST AND EVALUATION COMMAND, ABERDEEN PROVING GROUND, MD 21005-5055
USA RESEARCH LABORATORY, ADELPHI, MD 20783-1145
USA RESEARCH LABORATORY, ADVANCED COMPUTATIONAL AND INFORMATION SCIENCE DIRECTORATE, SIMULATION TECHNOLOGY DIVISION, ATTN: AMSRL-CI-S, ABERDEEN PROVING GROUND, MD 21005-5067
CDR, USA ARMAMENT RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, PICATINNY ARSENAL, NJ 07806-5000
CDR, USA BELVOIR RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, 10101 GRIDLEY ROAD , SUITE 104, FORT BELVOIR, VA 22060-5818
CDR, USA NATICK RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, NATICK, MA 01760-5000
CDR, USA CORPS OF ENGINEERS, ATTN: CERD-ZA, 20 MASSACHUSETTS AVENUE, NW, WASHINGTON, DC 20314-1000
CDR, USA INFORMATIONS SYSTEMS COMMAND, ATTN: ASQB-OSA, FORT HUACHUCA, AZ 85613-5000
CDR, USA LOGISTICS EVALUATION AGENCY, ATTN: LOEA-PL, NEW CUMBERLAND, PA 17070-5007
CDR, BALLISTIC MISSILE DEFENSE SYSTEMS COMMAND, PO BOX 150, HUNTSVILLE, AL 35807-3801
CDR, USA TEST AND EXPERIMENTATION COMMAND, FORT HOOD, TX 76544-5065
CDR, TEST AND EXPERIMENTATION COMMAND EXPERIMENTATION CENTER, FORT ORD, CA 93941-7000
(CONT)

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

DISTRIBUTION: (CONT)
DIR USA TOPOGRAPHIC ENGINEERING CENTER, ATTN: CDTEC-ZA, FORT BELVOIR, VA 22060-5546
DIR, USA RESEARCH INSTITUTE FOR THE BEHAVIORAL AND SOCIAL SCIENCES, ATTN: PERI-ZA, 5001 EISENHOWER AVENUE, ALEXANDRIA, VA 22333
DIR, USA RESEARCH OFFICE, P.O. BOX 12211, RESEARCH TRIANGLE PARK, NC 27709-2211
DIR, COMMUNICATIONS-ELECTRONICS RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, FORT MONMOUTH, NJ 07703
DIR, RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, USA MISSILE COMMAND, REDSTONE ARSENAL, AL 35898-5000
DIR USA TANK-AUTOMOTIVE RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, WARREN, MI 48397-5000
DIR, USA AVIATION RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, 4300 GOODFELLOW BOULEVARD, ST. LOUIS, MO 63120-1798
DIR, USA EDGEWOOD RESEARCH, DEVELOPMENT AND ENGINEERING CENTER, ABERDEEN PROVING GROUND, MD 21010-5423
DIR, USA MISSILE SPACE AND INTELLIGENCE CENTER, REDSTONE ARSENAL, AL 35898-5500
DIR, USA COLD REGIONS RESEARCH AND ENGINEERING LABORATORY, 72 LYME ROAD, HANOVER, NH 03755-1290
DIR, WATERWAYS EXPERIMENT STATION, 3909 HALLS FERRY RD, VICKSBURG, MS 39180
DIR, USA CONCEPTS ANALYSIS AGENCY, ATTN: CSCA-ZA, 8120 WOODMONT AVENUE, BETHESDA, MD 20814-2797
DIR, USA MATERIEL SYSTEMS ANALYSIS ACTIVITY, ATTN: AMXSY-D, ABERDEEN PROVING GROUND, MD 21005-5071
DEPUTY COMMANDING GENERAL FOR COMBINED ARMS, ATTN: ATDC-CA, FORT LEAVENWORTH, KS 66027-5000
CDR, USATRADOC, ATTN: ATCD-B, FORT MONROE, VA 23651-5000
CDR, USACAC, ATTN: ATZL-NSC, FORT LEAVENWORTH, KS 66027
CDR, USACAC, ATTN: ATZL-CT, FORT LEAVENWORTH, KS 66027
CDR, USACAC, ATTN: ATZL-CDC, FORT LEAVENWORTH, KS 66027
CDR, USA TRAINING SUPPORT CENTER, ATTN: ATIC-DMD, FORT EUSTIS, VA 236604-5389
CDR, USACASCOM, FORT LEE, VA 23801-6000
CDR, USACASCOM, ATTN: ATCL-B, FORT LEE, VA 23801-6000
CDR, USACASCOM, ATTN: ATCL-L, FORT LEE, VA 23801-6000
CDR, USAAVNC, ATTN: ATZQ-CD, FORT RUCKER, AL 36362-5188
(CONT)

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

DISTRIBUTION: (CONT)
CDR, USAAVNC, ATTN: ATZQ-CDB, FORT RUCKER, AL 36362-5188
CDR, USAAVNC, ATTN: ATZQ-DSO, FORT RUCKER, AL 36362-5263
CDR, USA SIGNAL CENTER, ATTN: ATZH-BL, FORT GORDON, GA 30905-5299
TSM, CATT, ATTN: ATZK-SM, 1109C 6TH AVENUE, FT KNOX, KY 40121-5000
DIR, USATRAC, ATTN: ATRC, FORT LEAVENWORTH, KS 66027-5200
DIR, USA TRAC, ATTN: ATRC-L, FORT LEE, VA 23801-6140
DIR, USA TRAC, ATTN: ATRC-W, WHITE SANDS MISSILE RANGE, WHITE SANDS, NEW MEXICO 88002
DIR, USA TRAC, ATTN: ATRC-SA, FORT LEAVENWORTH, KS 66027
DIR, USA TRAC, ATTN: ATRC-F, FORT LEAVENWORTH, KS 66027
DIR, USA TRAC, ATTN: ATRC-TD, FORT LEAVENWORTH, KS 66027
DIR, USA TRAC, ATTN: ATRC-RDM, P.O. BOX 8692, NAVAL POST GRADUATE SCHOOL, MONTEREY, CA 93943-0692
CDR, USA INFANTRY CENTER AND FORT BENNING, FORT BENNING, GA 31905-5000
CDR, USAADACENFB, 1733 PLEASONTON RD, FORT BLISS, TX 79916-6816
CDR, US ARMY TRANSPORTATION CENTER AND FORT EUSTIS, FORT EUSTIS, VA 23604-5000
CDR, US ARMY SIGNAL CENTER AND FORT GORDON, FORT GORDON, GA 30905-5000
CDR, US ARMY TRAINING CENTER AND FORT JACKSON, FORT JACKSON, SC 29207-5000
CDR, US ARMY ARMOR CENTER AND FORT KNOX, FORT KNOX, KY 40121-5000
CDR, US ARMY CHEMICAL AND MILITARY POLICE CENTERS AND FORT MCCLELLAN, FORT MCCLELLAN, AL 36205-5000
COMMANDER, US ARMY AVIATION CENTER AND FORT RUCKER, FORT RUCKER, AL 36362-5000
CDR, US ARMY FIELD ARTILLERY CENTER AND FORT SILL, FORT SILL, OK 73503-5000
CDR, US ARMY INTELLIGENCE CENTER AND FORT HUACHUCA, FORT HUACHUCA, AZ 85613-6000
CDR, US ARMY ENGINEER CENTER AND FORT LEONARD WOOD, FORT LEONARD WOOD, MO 65473-5000
CDR, USAARMC, ATTN: ATZK-MW, FORT KNOX, KY 40121-5000
CDR, USAARMC, ATTN: ATZK-CDF, FORT KNOX, KY 40121-5000
COMDT, USAFAS, ATTN: ATSF-CBL, FORT SILL, OK 73503-5600
COMDT, USA AIR DEFENSE ARTILLERY SCHOOL, FORT BLISS, TX 79916-7000
(CONT)

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

DISTRIBUTION: (CONT)
COMDT, USA AIR DEFENSE ARTILLERY SCHOOL, ATTN: ATSA-ADL, FORT BLISS, TX 79916-3802
COMDT, USAIS, ATTN: ATSH-WC, FORT BENNING, GA 31905-5007
COMDT, USA CHEMICAL SCHOOL, ATZN-CM-CB, FORT MCCLELLAN, AL 36205-6607
COMDT, USA ENGINEER SCHOOL, ATTN: ATSE-CD-B, FORT LEONARD WOOD, MO 65473
COMDT, USA MILITARY INTELLIGENCE SCHOOL, ATTN: ATZS-CD, FORT HUACHUCA, AZ 85613
COMDT, USA MILITARY INTELLIGENCE SCHOOL, ATTN: ATZS-CDT, FORT HUACHUCA, AZ 85613
COMDT, USA MILITARY POLICE SCHOOL, ATTN: ATZN-MP-C, FORT MCCLELLEN, AL 6205-55030
COMDT, USA MILITARY POLICE SCHOOL, ATTN: ATZN-MP-CCC, FORT MCCLELLAN, AL 6205-55030
COMDT, US ARMY ORDNANCE MISSILE AND MUNITIONS CENTER AND SCHOOL, REDSTONE ARSENAL, AL 35897-6000
CDR, US ARMY ORDNANCE CENTER AND SCHOOL, ABERDEEN PROVING GROUND, MD 21005-5201
COMDT, ARMY WAR COLLEGE, ATTN: AWC-AW, CARLISLE BARRACKS, PA 17013
COMDT, US ARMY COMMAND AND GENERAL STAFF COLLEGE, FORT LEAVENWORTH, KS 66027-6900
COMDT, USA LOGISTICS MANAGEMENT COLLEGE, FORT LEE, VA 23801
SUPERINTENDENT, US MILITARY ACADEMY, WEST POINT, NY 10996-5000
COMDT, ARMED FORCES STAFF COLLEGE, NORFOLK, VA 23511-6097

CF:
DEPUTY UNDER SECRETARY OF THE ARMY (OPERATIONS RESEARCH), ATTN: SAUS-OR, RM 2E660, 102 ARMY PENTAGON, WASHINGTON, DC 20310-0102
DEPUTY CHIEF OF STAFF FOR OPERATIONS AND PLANS, ATTN: DAMO-ZA, RM 3E634, 400 ARMY PENTAGON, WASHINGTON DC 20310-0400
DEPUTY CHIEF OF STAFF FOR OPERATIONS AND PLANS, ATTN: DAMO-ZD, RM 3A538, 400 ARMY PENTAGON, WASHINGTON, DC 20310-0400
ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH, DEVELOPMENT, AND ACQUISITION, ATTN: SARD-ZT, RM 3E374, 103 ARMY PENTAGON, WASHINGTON, DC 20310-0103

ATAN-SM
SUBJECT: Environmental Effects for Distributed Interactive Simulation (E2DIS) Project Requirements Survey

DISTRIBUTION: (CONT)
ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH, DEVELOPMENT, AND ACQUISITION, ATTN: SARD-ZB, 103 ARMY PENTAGON, WASHINGTON, DC 20310-0103
ASSISTANT SECRETARY OF THE ARMY FOR RESEARCH, DEVELOPMENT AND ACQUISITION, ATTN: SARD-ZD, RM 2E673, 103 ARMY PENTAGON, WASHINGTON, DC 20310-0103
DEPUTY CHIEF OF STAFF FOR PERSONNEL, ATTN: DAPE-MR, RM 2C733, 300 ARMY PENTAGON, WASHINGTON, DC 20310-0300
OFFICE OF THE DEPUTY CHIEF OF STAFF FOR INTELLIGENCE, ATTN: DAMI-PII, RM 2E464, 1000 ARMY PENTAGON, WASHINGTON, DC 20310-1000
DIR, INFORMATION SYSTEMS FOR COMMAND, CONTROL, COMMUNICATIONS, AND COMPUTERS, ATTN: SAIS-ADM, RM 1C670, 107 ARMY PENTAGON, WASHINGTON, DC 20310-0107
LOGISTICS MANAGEMENT INSTITUTE, 6400 GOLDSBORO RD, BETHESDA, MD 20817-5887
CDR, USA FOREIGN SCIENCE AND TECHNOLOGY CENTER , CHARLOTTESVILLE, VA 22901-5396
DIR, ARMY MODEL AND SIMULATION MANAGEMENT OFFICE, ATTN: SFUS-MIS, SUITE 808, CRYSTAL SQUARE II, 1725 JEFFERSON DAVIS HIGHWAY, ARLINGTON, VA 22202
CDR, USATRADOC, DEPUTY CHIEF OF STAFF FOR COMBAT DEVELOPMENTS, ATTN: ATCD-ZA, FORT MONROE, VA 23651-5000
CDR, USATRADOC, DEPUTY CHIEF OF STAFF FOR TRAINING, ATTN: ATTG-ZA, FORT MONROE, VA 23651-5000
DIR, LAM TF, ATTN: DACS-LM, FORT MONROE, VA 23651

Environmental Effects for Distributed Interactive Simulation

(E2DIS)

Project and Survey Task Summary

In 1993, the DoD Modeling and Simulation Working Group recommended via the Executive Council for Modeling and Simulation and the Under Secretary of Defense (Acquisition and Technology) approved the multi-service E2DIS Project for funding. Consistent with the Defense initiative emphasizing the creation of synthetic environments, one of the project's primary goals is to develop an overall methodology for incorporating appropriate fidelity, physics-based representations of the environment and environmental effects using DIS protocols. The E2DIS Project development methodology includes a series of demonstrations that incorporate the effects of atmospheric phenomena, such as clouds, temperature, wind and visibility, on military systems.

A Program Development Plan (PDP) describes how the E2DIS Project Team will achieve the project's goals in terms of seven task areas. It describes in detail how each of these tasks will be conducted. As cited in the PDP, Task 5, the Survey of Requirements and Capabilities, consists of two sub-tasks:

Sub-task 1: Determine the major modeling and simulation environmental requirements (current and anticipated) for Army, Navy, Air Force, and Marine Corps' weapon systems operating in the atmosphere and near-space.

Sub-task 2: Identify existing environmental models and data bases available to support simulation activities and assess their applicability and fidelity.

The results of these two sub-tasks will be published in three documents:

- The *Environment Simulation Requirements Document*
- The *Environment Model and Database Catalog*
- The *Analysis and Required New Capabilities Document*

Enclosure 1

Environmental Effects for Distributed Interactive Simulation

(E2DIS)

Requirements Survey Guidelines

Survey Team. To accomplish the work associated with the Survey Task, the E2DIS Project has selected Science and Technology Corporation (STC) to interface with the Services and other Government agencies. STC Survey Team members include: Dr. Paul Try, John Burgeson, Ken Eis, Carl Chesley, Jerry Johnson, Paul Cooper, and Tom Piwowar.

Survey Procedure.

1. Your organization forwards a list of major M&S efforts and technical points of contacts (POCs) for each effort to STC.

2. Within five (5) working days after receipt of the list, and STC Survey Team member contacts your technical POC to schedule an interview (either on-site or via telephone) to complete the Requirements Questionnaire. A copy of the questionnaire is attached; copies should be made available to each technical POC.

3. Prior to the interview, technical POCs should review the questionnaire and enter as many responses as possible. Approximately one and one-half hours should be allotted for the STC Survey Team to conduct each Requirements Survey interview.

4. Completed questionnaires should be forwarded immediately to:

Science and Technology Corporation
ATTN: Tom Piwowar
409 Third Street, S.W.
Suite 203
Washington, D.C. 20024

Facsimile: (202) 488-5364
Phone: (202) 863-0012

Government Point of Contact. The Army representative for the E2DIS Project's Survey Task is :

Dr. Alan Wetmore
Army Research Laboratory

Phone: (505) 678-5563
Facsimile: (505) 678-8366

Dr. Wetmore should be notified on any issues that might arise during the execution of this survey.

Enclosure 2

TEAM MIKE MEMO

1 August 1994

MEMORANDUM FOR DISTRIBUTION

Subject: Distribution List for the E²DIS Project's Requirements Questionnaire

Encl: (1) E²DIS Project Modeling & Simulation (M&S) **Requirements** Questionnaire

The DMSO funded Environmental Effects for DIS (E²DIS) project has generated a questionnaire (enclosure 1) to survey DoD requirements on M&S and the environment. The organizations listed under distribution have been selected from the Team Mike participants to represent Navy's input in the five DMSO-defined M&S functional areas (T&E, R&D, Analysis, Training, and Logistics). Other ways to categorize the M&S information are constructive, virtual, live play as well as level of fidelity and scalability.

We request that the Team Mike representatives get the survey to the proper person/s (unless you are it) to be completed and returned by August 29th,1994. In return, the respondees will receive a document outlining all services' M&S efforts, needs, and requirements for environmental data (ETC: March 95). In addition, from the "capabilities" survey--not included in this package--the same respondees will receive a document consisting of all the available/applicable environmental databases and models (ETC: March'95). Your input will also help E²DIS develop methodologies and toolboxes for users to incorporate the environment in a DIS domain.

The point of contact for the E²DIS questionnaire is **Tom Piwowar** at the Science and Technology Corp. located at 409 3rd st. SW, Suite 203, Washington, DC 20024. His phone number is (202) 863-0012 and his fax number is (202) 488-5364. Thank you for your cooperation.

Very respectfully;

George Phillips

Subject: Distribution List for the E²DIS Project's Requirements Questionnaire

Distribution List:
CINCLANTFLT
CINCPACFLT
CINCUSNAVEUR
CNA
COMTRALANT
COMTRAPAC
COMOPTEVFOR
COMSUBDEVRON 12
NAVAIRSYSCOM
NAVAIRWARCEN (DC, WD, AC, AD)
NAVCOMTELCOM
NAVDOCTRINECOM
NAVFACSYSCOM
NAVSEASYSCOM
NAVSPECWARCEN
NAVSTRIKEWARCEN & NAVFITWEPSCOL
NAVSUPSYSCOM
NAVSURFWARCEN (Carderock, Dahlgren, Port Hueneme, Panama City, Indian Head)
NAVUNSEAWARCEN (New London, Newport, Keyport)
NAVWARANALCEN
NAVWARCOL
NAWC-TSD
NCCOSC
NRL (DC only)
OCNR
SPAWARSYSCOM
TACTRAGRULANT
TACTRAGRUPAC

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS UNITED STATES AIR FORCE

5 JUL 1994

MEMORANDUM FOR SEE DISTRIBUTION

FROM: HQ USAF/XOW
1490 Air Force Pentagon
Washington DC 20330-1490

SUBJECT: Environmental Effects for Distributed Interactive Simulation (E^2DIS) Project Modeling & Simulation Requirements Questionnaire

One of the E^2DIS project's primary goals is to develop an overall methodology for incorporating appropriate fidelity, physics-based representations of the environment and environmental effects using Distributed Interactive Simulation (DIS) protocols. To help meet these goals, the E^2DIS Project Team has selected Science and Technology Corporation (STC) to survey the Services and other Government agencies.

The attached Requirements Questionnaire is specifically intended to:

a. Determine the major modeling and simulation environmental requirements (current and anticipated) for Army, Navy, Air Force, and Marine Corps weapon systems operating in the atmosphere and near-space.

b. Identify existing environmental models and data bases available to support simulation activities and assess their applicability and fidelity.

Please have your technical POC, i.e., a "modeler" rather than a "user," review the questionnaire and enter as many responses as possible. A member of the STC Survey Team will contact each agency to schedule an interview with the technical POC, either on-site or via telephone, to complete the questionnaire. Plan on 90 minutes for the interview.

Send completed surveys, to arrive by *8 Aug 94*, to:

Science and Technology Corporation
Attn: Tom Piwowar
409 Third Street, S.W.
Suite 203
Washington, D.C. 20024

Facsimile: (202) 488-5364
Phone: (202) 863-0012

If you have any comments or questions, my POC is Maj Mike Remeika, DSN 223-8277 or Commercial (703) 693-8277.

THOMAS F. TASCIONE, Colonel, USAF
Deputy Director of Weather
DCS, Plans and Operations

Attachments:
1. Distribution List
2. Requirements Questionnaire

cc:
HQ USAF/XOM
HQ USAF/XOOT
HQ AWS/XT
USAFETAC/SYT

DISTRIBUTION LIST

HQ ACC/DOST (Attn: Maj Mattison)
205 Dodd Blvd Suite 101
Langley AFB VA 23665-2789

HQ ACC/DOT (Attn: Ken Madison)
205 Dodd Blvd Suite 101
Langley AFB VA 23665-2789

HQ AETC/XOR (Mr Pat Bowden)
1 F St Suite 2
Randolph AFB TX 78150

HQ AFMC/XRT (Attn: Mr Larry O'Grady)
Wright Patterson AFB OH 45433

HQ AFOTEC/SAN (Attn: Lt Col W Koozin)
8500 Gibson Blvd SE
Kirtland AFB NM 87117-5558

AFOTEC/TFT
8500 Gibson Blvd SE
Kirtland AFB NM 87117-5558

HQ AFSOC/DOT
100 Bartley St
Hurlburt Fld FL 32544

HQ AFSPACECOM/DRR (Attn: Maj Converse)
150 Vandenberg St Suite 1105
Peterson AFB Co 80914-4170

Air University
CADRE/WG (Attn: Col Collson)
401 Chennault Circle
Maxwell AFB AL 36112-6428

HQ AMC/XOTS (Attn: Maj Stahre)
402 Scott Dr Unit 3A1
Scott AFB IL 62225-5302

ANGRC/DOE (Lt Col Tom Vierzba)
1400 28th Ave N, Bldg 80002
Fargo, ND 58102-1051

Phillips Laboratory (Attn: Lt Col Johnson)
Bldg 914/Satellite Assessment Center
Kirtland AFB NM 87117-5670

Space Warfare Center/XR (Attn: Lt Col L Raney)
730 Irwin Avenue
Falcon AFB CO 80912-7300

619 TRSS/IDS (Maj Searcey)
1150 5th St E Suite 2
Randolph AFB TX 78150-4404

29 TSS (Attn: Lt Col Kirkpatrick)
203 West D Ave, Suite 400
Eglin AFB FL 32542-6867

USAF BTS
138 Harlson Street
Hurlburt AFB FL 32544-5231

HQ USAF/TEP (Attn: Maj B Ishihara)
1530 Air Force Pentagon
Washington DC 20330-1530

HQ USAF/XOMW (Attn: Col Peterman)
1480 Air Force Pentagon
Washington DC 20330-1480

HQ USAF/XOMW (Attn: Lt Col D Smith)
1480 Air Force Pentagon
Washington DC 20330-1480

HQ USAF/XOOT (Attn: Lt Col Christian)
1480 Air Force Pentagon
Washington DC 20330-1480

HQ USAFE/DOT
Unit 3050 Box 15
APO AE 09094-5015

Armstrong Laboratory (AL)/HRA (Attn: Col Lynne Carol)
6001 S Power Rd Bldg 558
Mesa, AZ 85206-0904

ASC/RWWW (JMASS) (Attn: Mr Mark Savchitz)
Wright Patterson AFB OH 45433

ASC/YT (Attn: Mr Bill Curtis)
Wright Patterson AFB OH 45433

ASC/YWE (Attn: Mr Brown)
Bldg 14
1865 4th St Suite 11
Wright-Patterson AFB OH 45433-7125

Chief Naval Operations (Attn: CMDR Clager)
2000 Navy Pentagon Rm 4E419
Washington DC 20350-2000

NAWAD (Attn: Mr McCrillis)
NAWAD SA102
Patuxent River MD 20670

58 OG/DOU (Attn: Mr Smith)
4249 Hercules Way
Kirtland AFB NM 87117-5861

58 OG/DOU (Attn: Lt Col E Reed)
4249 Hercules Way
Kirtland AFB NM 87117-5811

4444 OPS (Attn: Maj Charpollios)
752 Durand Rd
Langley AFB VA 23665-2596

Det 1, 4444 OPS (Attn: Lt Col Poe)
7045 N Fighter Country Ave
Luke AFB AZ 85309-1637

HQ PACAF/DOT (Mr Baker)
25 E St Suite 1232
Hickam AFB HI 96853-5426

Environmental Effects for Distributed Interactive Simulation

(E^2DIS)

Project and Survey Task Summary

In 1993, the DoD Modeling and Simulation Working Group recommended via the Executive Council for Modeling and Simulation and the Under Secretary of Defense (Acquisition and Technology) approved the multi-Service E^2DIS Project for funding. Consistent with the Defense initiative emphasizing the creation of synthetic environments, one of the project's primary goals is to develop an overall methodology for incorporating appropriate fidelity, physics-based representations of the environment and environmental effects using Distributed Interactive Simulation (DIS) protocols. The E^2DIS Project development methodology includes a series of demonstrations that incorporate the effects of atmospheric phenomena, such as clouds, temperature, wind and visibility, on military systems.

A Program Development Plan (PDP) describes how the E^2DIS Project Team will achieve the project's goals in terms of seven task areas. It describes in detail how each of these tasks will be conducted. As cited in the PDP, Task 5, the Survey of Requirements and Capabilities, consists of two sub-tasks:

Sub-task 1: Determine the major modeling and simulation environmental requirements (current and anticipated) for Army, Navy, Air Force and Marine Corps' weapon systems operating in the atmosphere and near-space.

Sub-task 2: Identify existing environmental models and data bases available to support simulation activities and assess their applicability and fidelity.

The results of these two sub-tasks will be published in three documents:

- The *Environment Simulation Requirements Document*
- The *Environment Model and Database Catalog*
- The *Analysis and Required New Capabilities Document*

Attachment 1

Environmental Effects for Distributed Interactive Simulation

(E^2DIS) Project

Requirements Survey Guidelines

Survey Team. To accomplish the work associated with the Survey Task, the E^2DIS Project has selected Science and Technology Corporation (STC) to interface with the Services and other Government agencies. STC Survey Team members include: Dr. Paul Try, John Burgeson, Ken Eis, Carl Chesley, Jerry Johnson, Paul Cooper, and Tom Piwowar.

Survey Procedure.

1. Your organization forwards a list of major M&S efforts and technical points-of-contacts (PoCs) for each effort to STC.
2. Within five (5) working days after receipt of the list, an STC Survey Team member contacts your technical PoC to schedule an interview (either on-site or via telephone) to complete the Requirements Questionnaire. A copy of the questionnaire is attached; copies should be made available to each technical PoC.
3. Prior to the interview, technical PoCs should review the questionnaire and enter as many responses as possible. Approximately one and one-half hours should be allotted for the STC Survey Team to conduct each Requirements Survey interview.
4. Completed questionnaires should be forwarded immediately to:

Science and Technology Corporation
Attn: Tom Piwowar
409 Third Street, S.W.
Suite 203
Washington, D.C. 20024

Facsimile: (202) 488-5364
Phone: (202) 863-0012

Government Point-of-Contact. The Air Force representative and Leader for the E^2DIS Project's Survey Task is:

Mr. Donald Grantham
Phillips Laboratory (Hanscom Air Force Base, MA)

Phone: (617) 377-2982
Facsimile: (617) 377-2984

Mr. Grantham should be notified of any issues that might arise during the execution of this survey.

Attachment 2

APPENDIX C

DATABASE TABLES

C.1. DATABASE TABLES STRUCTURE

As was mentioned in the main body of this report, each database table contains relational information and a common field that allows the tables to be linked together. The primary method of linking various database tables is through the use of an arbitrary, but unique, number assigned to each questionnaire received. Each record (row), or group of records, in a table corresponds to a specific questionnaire; each field (column) corresponds to a specific response, or entry, from a questionnaire. In keeping with sound relational database development theory and practice, the database tables are small in terms of the number of fields. No table has more than 18 fields, and most tables have 10 or less.

Specific questions in the Requirements Questionnaire have been associated with, or mapped into, 23 *Paradox for Windows* database tables. In Table 1, these questions are listed and are associated with the appropriate database table. Note that Table 1 is a summary table and is organized according to the sequence of questions in the Requirements Questionnaire. It also provides reference to Section C.2., which follows, where each database table and field is described in detail.

Table 1. Summary of Requirements Questionnaire Database Tables

Questionnaire Sections	Database Table Title	Section C.2. Description Paragraph
Questions A.1., A.2., A.4., and A.5.	ADMIN.DB	C.2.1.
Questions A.3.	EXPERT.DB	C.2.2.
Questions B. 1., B.2., B.3.g., B.4., and B.5.a.	TECHNICL.DB	C.2.3.
Questions B.3.a.–B.3.f.	APLICATN.DB	C.2.4.
Question B. 5.b.(1) Questions C.1.–C.26. (1st–3rd columns)	CFRAD.DB	C.2.5.
Question B. 5.b.(2) Questions C.1.–C.23. (1st–3rd columns)	CFR_NSD.DB	C.2.6.
Question B.5.b.(3)	NOW_RQMT.DB	C.2.7.
Question B.5.c. Questions C.1–5.	OTHRQMTS.DB	C.2.8.
Question B.6.a., B.6.b., B.6.c. Question B.7.	FUTRQMTS.DB	C.2.9.

Table 1. Summary of Requirements Questionnaire Database Tables (Continued)

Questionnaire Sections	Database Table Title	Section C.2. Description Paragraph
Questions C.1.–C.26. (1st and 4th columns) Questions C.1.–C.23. (1st and 4th columns)	PREQDATA.DB	C.2.10.
Question D.1.	RAE_SNSR.DB	C.2.11.
Question D.2.	RAE_COMM.DB	C.2.12.
Question D.3.	RAE_WEAP.DB	C.2.13.
Question D.4.	RAE_PLAT.DB	C.2.14.
Question D.5.	RAE_FORC.DB	C.2.15.
Question D.6.	RAE_OTHR.DB	C.2.16.
Question D.1.	RNSDE_SN.DB	C.2.17.
Question D.2.	RNSDE_CM.DB	C.2.18.
Question D.3.	RNSDE_WS.DB	C.2.19.
Question D.4.	RNSDE_PL.DB	C.2.20.
Question D.5.	RNSDE_FO.DB	C.2.21.
Question D.6.	RNSDE_OT.DB	C.2.22.
Questions B.1. and B.2.	SAMEFIDL.DB	C.2.23.
No Specific Question(s)	RQ_NOTES.DB	C.2.24.

C.2. DATABASE TABLE DESCRIPTIONS

Each of the 24 database tables is described in detail below. The questions indicated refer to those of the Requirements Questionnaire.

C.2.1. ADMIN.DB. Questions A.1., A.2., A.4., and A.5. pertain to ADMINistrative information. Note that Question A.3., the question on the Technical Expert, is not included in this database table but is associated with a separate database table (i.e., EXPERT.DB) described in the next paragraph. The first field in ADMIN.DB, the model tracking number, is keyed to and has referential integrity with a similar field in all other database tables except EXPERT.DB. The technical expert may not be unique for each model; in

any case, ADMIN.DB and EXPERT.DB can be linked by the last name and first name fields. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the model tracking number uniquely assigned to the returned questionnaire.

Field 2 (A.1.) is the title for the simulation model.

Field 3 (A.2.) is the general description of the model.

Field 4 (A.3.a.) is the last name of the technical expert (the same entry as Field 1 in EXPERT.DB).

Field 5 (A.3.a.) is the first name of the technical expert (the same entry as Field 2 in EXPERT.DB).

Field 6 (A.4.) is the Service/Organization responsible for the model.

Field 7 (A.5.) is the organizational location of the model.

Field 8 is the date the returned questionnaire was received.

C.2.2. EXPERT.DB. Questions A.3.a. through A.3.d. are related to the technical EXPERT identified for the simulation model. Following is a description of each field for this database table. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 (A.3.a.) is the last name of the technical expert and the first part of the composite key (the same entry as Field 4 in ADMIN.DB).

Field 2 (A.3.a.) is the first name of the technical expert and the second part of the composite key (the same entry as Field 5 in ADMIN.DB).

Field 3 (A.3.a.) is the middle initial of the technical expert.

Field 4 (A.3.a.) is the rank/title of the technical expert.

Field 5 (A.3.b.) is the organizational title.

Field 6 (A.3.b.) is the first line of the organizational mailing address.

Field 7 (A.3.b.) is the second line of the organizational mailing address.

Field 8 (A.3.b.) is the city of the organizational mailing address.

Field 9 (A.3.b.) is the state of the organizational mailing address.

Field 10 (A.3.b.) is the organization's ZIP Code.

Field 11 (A.3.c.(1)) is the Office DSN phone number.

Field 12 (A.3.c.(1)) is the Office commercial phone number.

Field 13 (A.3.c.(2)) is the Office DSN fax number.

Field 14 (A.3.c.(2)) is the Office commercial fax number.

Field 15 (A.3.d.) is the E-mail address.

C.2.3. TECHNICL.DB. Questions B.1., B.2., B.3.g., B.4. and B.5.a. provide TECHNICaL information on the model or simulation. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the keyed (unique) model tracking number.

Field 2 (B.1.a.) describes the model's most critical environmental issues.

Field 3 (B.1.b.) describes where these issues are documented.

Field 4 (B2.) describes the status of the simulation/modeling effort.

Field 5 (B.3.g.) describes the most authoritative reference document(s).

Field 6 (B.4.a.) describes the primary horizontal surface domain.

Field 7 (B.4.a.) describes the secondary horizontal surface domain.

Field 8 (B.4.b.) describes the primary vertical surface domain.

Field 9 (B.4.b.) describes the secondary vertical surface domain.

Field 10 (B.4.c.(1)) is the typical time period being simulated.

Field 11 (B.4.c.(2)) is the maximum time period being simulated.

Field 12 (B.5.a.(1)) is the type of grid simulation typically used today by the simulation model.

Field 13 (B.5.a.(2)) is the type of map projection typically used today.

Field 14 (B.5.a.(3)) describes other types of grids and map projections.

C.2.4. APPLICATN.DB. Questions B.3.a.–B.3.f. provide information on the APPLICATioNs of the simulation or model. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique model tracking number.

Field 2 (B.3.a.) describes use in DIS.

Field 3 (B.3.b.) contains the predominant type of simulation.

Field 4 (B.3.b. continued) contains any of the two other types of simulation, if listed.

Field 5 (B.3.c.) contains the predominant of up to six functional uses.

Field 6 (B.3.c. continued) contains the other functional uses (if any).

Field 7 (B.3.d.) contains the predominant of up to five hierarchical levels.

Field 8 (B.3.d. continued) contains the remaining hierarchical levels, if any.

Field 9 (B.3.e.) contains the predominant of up to four types of applications supported.

Field 10 (B.3.e. continued) contains the remaining types of applications supported, if any.

Field 11 (B.3.f.(1)) describes the mission being simulated or modeled.

Field 12 (B.3.f.(2)) describes the forces being simulated or modeled.

Field 13 (B.3.f.(3)) describes the platforms being simulated or modeled.

Field 14 (B.3.f.(4)) describes the weapons systems being simulated or modeled.

Field 15 (B.3.f.(5)) describes the communications systems being simulated or modeled.

Field 16 (B.3.f.(6a)) describes the active sensors being simulated or modeled.

Field 17 (B.3.f.(6b)) describes the passive sensors being simulated or modeled.

Field 18 (B.3.f.(7)) describes the targets being simulated or modeled.

C.2.5. CFRAD.DB. Question B.5.b.(1), Current Fidelity Requirements for Atmospheric Data types, refers to Attachment 1, Questions C.1.–26., to identify specific atmospheric data types. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique model tracking number.

Field 2 (Attachment 1, Question C., column 1) is a keyed (unique) data type. Hence, Fields 1 and 2 make up a composite key. Entries in Field 2 are taken directly from the 26 data types listed in column 1, *e.g.*, low clouds would be entered as 3.e.(3). Thus, each required data type is a unique entry. The following six fields are associated with each unique data type entry.

Field 3 (first entry of column 3 of Attachment 1, Question C.) is the required horizontal grid spacing.

Field 4 (second entry of column 3 of Attachment 1, Question C.) is the required vertical grid spacing.

Field 5 (third entry of column 3 of Attachment 1, Question C.) is the required time resolution.

Field 6 (fourth entry of column 3 of Attachment 1, Question C.) is the unit of measure for the data type.

Field 7 (first bullet under the fourth entry of column 3 of 1, Question C.) is the required minimum range.

Field 8 (first bullet under the fourth entry of column 3 of Attachment 1, Question C) is the required maximum range.

Field 9 (second bullet under the fourth entry of column 3 of Attachment 1, Question C) is the required accuracy.

C.2.6. CFR_NSD.DB. Question B.5.b.(2), Current Fidelity Requirements for Near Space Data types, refers to Attachment 2 , Questions C.1.–23. to identify specific near-space-environment data types. Following is a description of each field for this database table. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique tracking number.

Field 2 (Attachment 2, Question C, column 1) is a keyed (unique) data type. Hence, Fields 1 and 2 make up a composite key. Entries in Field 2 are taken directly from the 23 data types listed in column 1, e.g., the geomagnetic field strength would be entered as 4.a. Thus, each required near space data type is a separate entry, and the remaining seven fields are associated with it.

Field 3 (Attachment 2, Question C, column 3) is the horizontal grid spacing in meters.

Field 4 (Attachment 2, Question C, column 3) is the vertical grid spacing in meters.

Field 5 (Attachment 2, Question C, column 3) is the required time resolution.

Field 6 (Attachment 2, Question C, column 3) is the unit of measure for the data type.

Field 7 (Attachment 2, Question C, column 3) is the required minimum range.

Field 8 (Attachment 2, Question C, column 3) is the required maximum range.

Field 9 (Attachment 2, Question C, column 3) is the required accuracy.

C.2.7. NOW_RQMT.DB. Question B.5.c. provides information on presently required environmental data and environmental effects not covered by questions in Attachments 1 and 2. Following is a description of each field for this database table. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique model tracking number.

Field 2 (B.5.b.(3)) describes any other required environmental data and/or effects not covered by questions in Attachments 1 and 2.

C.2.8. OTHRQMTS.D. Question B.5.c. and Attachment 3, Question C. provide information on the OTHer ReQuireMenTS for atmospheric data and effects. These requirements refer to the grouping of environmental data types identified in Attachment 1, Questions C. and D., and the requirements in

Question C. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 (Attachment 3, A.) is the unique model tracking number.

Field 3 (Attachment 3, C.1.a.) describes unique scalability requirements.

Field 4 (Attachment 3, C.2.a.(1)) describes the operating system software compatibility requirements.

Field 5 (Attachment 3, C.2.a.(2)) describes the programming language compatibility requirements.

Field 6 (Attachment 3, C.2.a.(3)) describes the database management system software compatibility requirements.

Field 7 (Attachment 3, C.2.a.(4)) describes the near-term software requirements changes.

Field 8 (Attachment 3, C.2.b.(1)) describes the hardware system compatibility requirements.

Field 9 (Attachment 3, C.2.b.(2)) describes whether the hardware system is transportable.

Field 10 (Attachment 3, C.2.b.(3)) describes the data media the system can accept.

Field 11 (Attachment 3, C.3.a.) describes the accessibility with respect to security.

Field 12 (Attachment 3, C.3.b.) describes the accessibility with respect to connectivity requirements.

Field 13 (Attachment 3, C.4.a.) describes the verification requirements.

Field 14 (Attachment 3, C.4.b.) describes the validation requirements.

Field 15 (Attachment 3, C.4.c.) describes the accreditation requirements.

Field 16 (Attachment 3, C.5.) describes the currency requirements.

C.2.9. FUTRQMTS.DB. Questions B.6. and B.7. relate to any changes to current and future requirements resulting from a planned model upgrade. These questions are also used to discuss whether an upgrade would be considered if presently unavailable environmental data or effects could be provided. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique model tracking number.

Field 2 (B.6.b.) describes either the reason for model upgrade or states that none is planned.

Field 3 (B.6.b.(1)(a)) describes the changes to "current requirements", *i.e.*, those identified in other tables.

Field 4 (B.6.b.(1)(b)) describes the reasons for the changes to "current requirements".

Field 5 (B.6.b.(2)(a)) describes either the new environmental data and effects (ED&E) required as a result of the upgrade, or those ED&E whose availability might result in stimulating an upgrade.

Field 6 is a response to either (B.6.b.(2)(b)), a description of the reasons for the new requirements; or (B.6.c.), a discussion of the potential value of acquiring presently unavailable environmental data or effects.

Field 7 (B.7.) contains the response to an offer to provide a briefing on atmospheric/near-space-environment data and effects.

C.2.10. PREQDATA.D. Attachments 1 and 2, column 4 of Question C., Potential REQuirements for specific DATA types. This database table includes both atmospheric (Attachment 1) and near-space-(Attachment 2) environment data requirements. Data already accounted for in CFRAD.DB is not included here. Following is a description of each field for this database table. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the unique model tracking number.

Field 2 (Attachment 1, Question C., column 4) is entered with descriptions of any of the 26 atmospheric data types listed in column 1 that have potential for being future requirements. For example, if potential future requirements exist for such atmospheric data as blowing dust, fog, and rain and snow, the entry would be 1.c.; 5.; 8.b.(1); and 8.b.(6).

Field 3 (Attachment 2, Question C., column 4) is entered with descriptions of the near space data types listed in column 1. For example, if potential future requirements exist for near space data and effects such as diffuse zodiacal infra-red emissions, interplanetary solar wind velocity, and meteoroid mass and density, the entry would be 3.a.; 5.b.(1); 8.a; and 8.c.

C.2.11. RAE_SNSR.DB. Attachment 1, Question D.1. provides information on the Requirements for Atmospheric Effects for SeNSoR systems. The database table's fields are the same as columns 1 and 2 of Question D.1. If more than one sensor system is described, additional sets of entries are made for each unique sensor system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the model tracking number, the first part of the composite key.

Field 2 (Attachment 1, Question D.1.a.) is the second part, i.e., the (unique) name of the sensor system, of the composite key.

Field 3 (Attachment 1, Question D.1.b.) is entered as the energy type(s) associated with the sensor system.

Field 4 (Attachment 1, Question D.1.c.) is entered as the type of sensor.

Field 5 (Attachment 1, Question D.1.d.) is entered as the environmental effect(s) required.

Field 6 (Attachment 1, Question D.1.e.) is entered as the line-of-sight sensor target geometry required.

Field 7 (Attachment 1, Question D.1.f.(1)) is entered as the required sensor altitude range .

Field 8 (Attachment 1, Question D.1.f.(2)) is entered as the target altitude range.

Field 9 (Attachment 1, Question D.1.g.(1)) is entered as the required quiescent environmental conditions.

Field 10 (Attachment 1, Question D.1.g.(2)) is entered as the required disturbed environmental conditions.

C.2.12. RAE_COMM.DB. Attachment 1, Question D.2. provides information on the Requirements for Atmospheric Effects for COMMunications systems. The database table's fields are the same as columns 1 and 2 of Question D.2. If more than one communications system is described, additional sets of entries are made for each unique communications system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the model tracking number, of the composite key.

Field 2 (Attachment 1, Question D.2.a.) is the second part, i.e., the (unique) name of the communications system, of the composite key.

Field 3 (Attachment 1, Question D2b) is entered as the energy type(s) associated with the communications system.

Field 4 (Attachment 1, Question D2c) is entered as the environmental effect(s) required.

Field 5 (Attachment 1, Question D2d) is entered as the transmitter-receiver geometry required.

Field 6 (Attachment 1, Question D2e(1)) is entered as the required transmitter altitude range .

Field 7 (Attachment 1, Question D2e(2)) is entered as the receiver altitude range).

Field 8 (Attachment 1, Question D2f(1)) is entered as the required quiescent environmental conditions.

Field 9 (Attachment 1, Question D2f(2)) is entered as the required disturbed environmental conditions.

C.2.13. RAE_WEAP.DB. Attachment 1, Question D.3. provides information on the Requirements for Atmospheric Effects for WEAPon systems. The database table's fields are the same as columns 1 and 2 of Question D.3. If more than one weapon system is described, additional sets of entries are made for each unique weapon system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 1, Question D.3.a.) is the second part, i.e., the (unique) name of the weapons system, of the composite key.

Field 3 (Attachment 1, Question D3b) describes the required atmospheric effects on the performance of the weapons system.

C.2.14. RAE_PLAT.DB. Attachment 1, Question D.4. provides information on the Requirements for Atmospheric Effects for PLATforms. The database table's fields are the same as columns 1 and 2 of Question D.4. If more than one platform is described, additional sets of entries are made for each unique platform. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 1, Question D.4.a.) is the second part, i.e., the name of the platform, of the composite key.

Field 3 (Attachment 1, Question D.4.b.) describes the required atmospheric effects on the performance of the platform.

C.2.15. RAE_FORC.DB. Attachment 1, Question D.5. provides information on the Requirements for Atmospheric Effects for FORCes. If more than one force is described, additional sets of entries are made for each unique force. The database table's fields are the same as columns 1 and 2 of Question D.5. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 1, Question D.5.a.) is the second part, i.e., the (unique) name of the force, of the composite key.

Field 3 (Attachment 1, Question D.5.b.) describes the required atmospheric effects on the performance of the force.

C.2.16. RAE_OTHR.DB. Attachment 1, Question D.6. provides information on the Requirements for Atmospheric Effects for any OTHER type systems. The database table's fields are the same as columns 1 and 2 of Question D.6. If more than one "other" type system is described, additional sets of entries are made for each unique system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 1, Question D6a) is the second part, i.e., the (unique) name of the other system, of the composite key.

Field 3 (Attachment 1, Question D6b) describes the required atmospheric effects on the performance of the other system.

C.2.17. RNSDE_SN.DB. Attachment 2, Question D.1. provides information on the Requirements for Near Space Data and Effects for SeNsor systems. The database table's fields are the same as columns 1 and 2 of Question D.1. If more than one sensor system is described, additional sets of entries are made for each sensor system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the model tracking number, of the composite key.

Field 2 (Attachment 2, Question D.1.a.) is the second part, i.e., the (unique) name of the sensor system, of the composite key.

Field 3 (Attachment 2, Question D.1.b.) is entered as the energy type(s) associated with the sensor.

Field 4 (Attachment 2, Question D.1.c.) is entered as the type of sensor.

Field 5 (Attachment 2, Question D.1.d.) is entered as the environmental effect(s) required.

Field 6 (Attachment 2, Question D.1.e.) is entered as the line-of-sight sensor target geometry required.

Field 7 (Attachment 2, Question D.1.f.(1)) is entered as the required sensor altitude range .

Field 8 (Attachment 2, Question D.1.f.(2)) is entered as the target altitude range.

Field 9 (Attachment 2, Question D.1.g.(1)) is entered as the general state of the required quiescent environmental conditions.

Field 10 (Attachment 2, Question D.1.g.(2)) is entered as the general state of the required disturbed environmental conditions .

C.2.18. RNSDE_CM.DB. Attachment 2, Question D.2. provides information on the Requirements for Near Space Data and Effects for CoMmunications systems. The database table's fields are the same as columns 1 and 2 of Question D.2. If more than one communications system is described, additional sets of entries are made for each communications system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the model tracking number, of the composite key.

Field 2 (Attachment 2, Question D.2.a.) is the second part, i.e., the (unique) name of the communications system, of the composite key.

Field 3 (Attachment 2, Question D.2.b.) is entered as the energy type(s) associated with the communications system.

Field 4 (Attachment 2, Question D.2.c.) is entered as the environmental effect(s) required .

Field 5 (Attachment 2, Question D.2.d.) is entered as the transmitter-receiver geometry required.

Field 6 (Attachment 2, Question D.2.e.(1)) is entered as the required transmitter altitude range.

Field 7 (Attachment 2, Question D.2.e.(2)) is entered as the receiver altitude range.

Field 8 (Attachment 2, Question D.2.f.(1)) is entered as the general state of the required quiescent environmental conditions.

Field 9 (Attachment 2, Question D.2.f.(2)) is entered as the general state of the required disturbed environmental conditions.

C.2.19. RNSDE_WS.DB. Attachment 2, Question D.3. provides information on the Requirements for Near Space Data and Effects for Weapons Systems. The database table's fields are the same as columns 1 and 2 of Question D.3. If more than one weapon system is described, additional sets of entries are made for each weapon system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 2, Question D3a) is the second part, i.e., the (unique) name of the weapons system, of the composite key.

Field 3 (Attachment 3, Question D3b) describes the required near space effects on the performance of the weapons system.

C.2.20. RNSDE_PL.DB. Attachment 2, Question D.4. provides information on the requirements for Near Space Data and Effects for PLatforms. The database table's fields are the same as columns 1 and

2 of Question D.3. If more than one platform is described, additional sets of entries are made for each platform. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 2, Question D4a) is the second part, i.e., the (unique) name of the platform, of the composite key.

Field 3 (Attachment 2, Question D4b) describes the required near space effect on the performance of the platform.

C.2.21. RNSDE_FO.DB. Attachment 2, Question D.5. provides information on the Requirements for Near Space Data and Effects for FOrces. The database table's fields are the same as columns 1 and 2 of Question D.5. If more than one force is described, additional sets of entries are made for each force. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 2, Question D5a) is the second part, i.e., the (unique) name of the force, of the composite key.

Field 3 (Attachment 2, Question D5b) describes the required near space effects on the performance of the force.

C.2.22. RNSDE_OT.DB. Attachment 2, Question D.6. provides information on the Requirements for Near Space Data and Effects for OTher systems. The database table's fields are the same as columns 1 and 2 of Question D.6. If more than one "other" type system is described, additional sets of entries are made for each "other" type system. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 is the first part, i.e., the unique model tracking number, of the composite key.

Field 2 (Attachment 2, Question D.6.a.) is the second part, i.e., the (unique) name of the (other) object, of the composite key.

Field 3 (Attachment 2, Question D.6.b.) describes the required near space effects on the performance of the object.

C.2.23. SAMEFIDL.DB. Attachment 3, Questions B.1. and B.2. provide information on the groupings of environmental data types identified in Attachment 1, Questions C. and D., which have the SAME FIDiLity requirements. Each field for this database table is described below. In parentheses after the field number is the relevant question from the Requirements Questionnaire.

Field 1 (Attachment 3, Question A.) is the unique model tracking number (*i.e.*, the same name entered in Field 2 of the ADMIN.DB database table), and the first part of the composite key.

Field 2 (Attachment 3, Question B.1.) is the second and final part of the composite key. Entries will be in the form of the letters "C" and "D" followed by numbers indicating groupings of atmospheric environmental data types from Attachment 1.

Field 3 (Attachment 3, Question B.2.) entries are the letters "C" and "D" followed by numbers indicating near-space-environment data types from Attachment 2.

C.2.24. RQ_NOTES.DB. This is the only table that does not have a one-to-one correspondence with questions in the questionnaire. The purpose of this database table is to provide space for NOTES on the model or simulation. Each field for this database table is described below.

Field 1 is the keyed (unique) model tracking number.

Field 2 is nonformatted for recording comments and observations made during the interview process.

APPENDIX D

DATABASE MANAGEMENT SYSTEM REPORTS

Report File Name	Report Description
ATMOSFDL.RSL	Sorts all the required atmospheric data types and shows their fidelity.
APPLIST.RSL	Sorts models by service; lists model applications.
COUNTAPS.RSL	Sorts and counts models by service, simulation type, hierarchical level, and functional use.
FIDELAPP.RSL	Sorts models as in COUNTAPS.RSL and provides a discussion to accompany table of fidelity requirements.
LAND-SEA.RSL	Sorts those models whose predominant domain is land or ocean by service.
MODELAPS.RSL	Sorts models by service, application, and fidelity.
MODELIST.RSL	Sorts models first by service, then alphabetically. Also describes each model and its critical environmental factors/ issues.
MTRXATMO.RSL	Counts atmospheric data type requirements, then sorts by hierarchy and functional use of the model.
MTRXFUTR.RSL	Similar to MTRXATMO.RSL except it counts potential, or future, atmospheric data type requirements, then sorts by hierarchy and functional use of the model.
MTRXSPACE.RSL	Similar to MTRXATMO.RSL except it counts near space data type requirements, then sorts by hierarchy and functional use of the model.
OTHRQMTS.RSL	Lists all "other requirements" (cited in Attachment 3 of the Questionnaire) by model.
POT_RQMT.RSL	Lists all potential future data requirements.
RAE-COMM.RSL	Lists each model's communications system's requirements for atmospheric effects.
RAE-PLAT.RSL	Lists each model's platform's requirements for atmospheric effects.
SPACEFDL.RSL	Shows the required fidelity of near space data.

APPENDIX E

LIST OF

MAJOR MILITARY MODELS AND SIMULATIONS

Service or Agency	Titles of Models/Simulations
Army:	1. A^2ATD
	2. Aerophysics Hypervelocity Simulator
	3. Aggregate Level Simulation Protocol (ALSP)
	4. AIBE
	5. ALSIM
	6. Army Multiple Engagement Model (AMEM)
	7. AVCATT
	8. Aviation Trainers (AH64, CH47 & UH60 Simulators)
	9. AWSIM
	10. Battle Intelligence Collection Model (BICM)
	11. Battle Projection Center
	12.* Battlefield Environment Weapon System Simulation (BEWSS)
	13. BBS
	14. BDS-D
	15. Blast, Dust and Thermal (BLAST) Model
	16. Brigade Battalion Battle Simulation (BBBS)
	17. BULLET
	18. Camouflage Multispectral Engineering Library and Analysis Station (CAMELIAN)
	19. Case Generation Code (CGC)
	20. CASMO
	21. CASUALTY
	22. CB Effects into JANUS-A
	23. Close Combat Tactical Trainer (CCTT)
	24. Combat Modeling and Effects of Terrain
	25. Combat Service Support Training Support System (CSSTSS)
	26. Combined Arms and Support Task Force Evaluation Model (CASTFOREM)
	27. Command and Control (C^2)
	28. Communications-on-the-Move Radio Model (CMRM)
	29. Corps Battle Simulation (CBS)
	30. Corps Level Computer Generated Forces (CLCGF)
	31. Cost and Logistics (COLOG)
	32. COMO
	33. Crane Simulator
	34. Defense Laser/Target Signature Simulator (DELTAS)
	35. Dyna-METRIC
	36. Dynamic Ground Target Simulator (DGTS)
	37. Dynamic Environment and Terrain (DET) Modeling in DIS
	38. EAGLE

* Models and simulations in **bold-face** indicate that a Requirements Questionnaire has been received for them, and the data from the questionnaires have been entered into the E^2DIS Project Requirements Survey database.

Service or Agency	Titles of Models/Simulations
Army: (continued)	39. Engagement Skills Trainer
	40. Extended Air Defense Simulation (EADSIM)
	41. Extended Air Defense Simulation (EADSIM) Threat Database
	42. Extended Air Defense Test Bed (EADTB)
	43. Extended Combat Sustainability (ECS)
	44. FORCEM
	45. FOX Vehicle and CB/Smoke Atmospheric Models
	46. Graphical Input Aggregate Control (GIAC)
	47. GUARDFIST II
	48. GWARS
	49. High Speed Exoatmospheric Multiple Burst Model (HISEMM)
	50. Integrated Effects Tests for Survivability (INETS)
	51. Integrated Unit Simulation System (IUSS)
	52. Israeli Testbed
	53. ITEMS
	54. JANUS
	55. Joint Electronic Warfare Simulation (JECEWSI)
	56. Joint Modeling and Simulation System (J-MASS)
	57. Joint Theater Level Simulation (JTLS)
	58. Kinetic Energy Weapon Digital Emulation Center Simulation
	59. Kinetic Impact Debris Distribution (KIDD)
	60. Logistics Assessment Model (LOGAM I& II)
	61. Logistics Simulation (LOGSIM)
	62. Logistics-Over-the-Shore Site Selection (LOSSS)
	63. Logistics-Over-the-Shore Throughput Planner (LOTSTP)
	64. M & S Exchange Standards
	65. Missile Command Distributed Interactive Simulation Center (MICOM DIS Center)
	66. ModSAF
	67. Mounted Warfare Test Bed (MWTB)
	68. NATO Reference Mobility Model - II (NHRMM-II)
	69. NBC Training
	70. **Night on BDS/Paint-the-Night (NBDS/PN)**
	71. NUSSE4
	72. Optical Discrimination Analysis Program (ODA)
	73. Optical Signature (OPTSIG)
	74. PARCOMPT
	75. Research, Evaluation, and Systems Analysis (RESA)
	76. RTOS
	77. Shaded-Relief Maps from Digital Terrain Elevation Data
	78. Simulation Network (SIMNET)
	79. Static and Dynamic Code Analysis Tool (SADCA)
	80. SINCGARS Radio Model
	81. Smart Mine Simulator (SMS)
	82. Spectrum

Service or Agency	Titles of Models/Simulations
Army: (continued)	83. Survivability Planning Intercept Evaluation Tool (SPIET) 84. Surveillance Test Bed (STB) 85. Synthetic Theater of War (STOW) 86. System Simulation (SYSIM) 87. Tactical Simulation (TACSIM) 88. TACWAR **89. Terrain Evaluation Module (TEM)** 90. Terrain Fidelity for DIS-SAF 91. Testbed and Network Simulation Tool (TBNSIM) and Distributed Timing and Synchronization System 92. THAAD Integrated System Effectiveness Simulation (TISES) 93. Target Management System (TMS) 94. Theater Transition and Sustainment Model (TTMS) 95. Total Operational and Support Assessment Model (TOPSAM) 96. Total Radiation Environments Model (TREM) **97. Transportation Infrastructure Assessment (TIA)** 98. Truck Driver Trainers 99. United Kingdom Extended Air Defense Testbed 100. Urban Combat Computer Assisted Training System (UCATTS) 101. Value-Added Interim Terrain Data (ITD) 102. Vessel Bridge Simulator 103. VIC 104. Virtual Brigade 105. VLSTRACK **106. Warfighter Simulation (WARSIM) 2000** 107. Exoatmospheric Discrimination Simulation (XoDIS)
Navy:	1. Air Combat Electronic T&E Facility (ACETEF) **2. AEGIS AN/SPY-1A/B/D Firm Track Simulation** **3. AEGIS Radar System Controller Environmental Simulation (RSCES)** 4. AH-1W Helicopter Visual System 5. Air Combat Maneuvering Simulator 6. AV-8B Night Attack Weapons System Trainer 7. AV-8B Weapons System Trainer 8. Battle Force Tactical Training (BFTT) 9. CH-46E Weapon System Trainer 10. CH-53D Operational Flight Trainer **11. Chemical/Biological Agent Vapor, Liquid, and Solid Tracking (VLSTRACK)** **12. Combat System Engineering & Analysis System (CSEAL) Simulation System (CSS)** **13. Combat Systems Multi-Warfare Tactical Scenarios (CSMWTS)** 14. Common Operational Modeling, Planning and Support Strategy (COMPASS) **15. Composite Warfare Model (CWM) 3.4.0**

Service or Agency	Titles of Models/Simulations
Navy: (continued)	**16. Cruise Missile Mission Planning and Weapon Control Systems: Tomahawk Land Attack Missile (TLAM)**
	17. E-2C Aircraft Tactics Trainer (15F8B)
	18. E-2C Aircraft Tactics Trainer (15F8C)
	19.[1] Enhanced Naval Warfare Gaming System (ENWS)
	20.[1] Enhanced Naval Warfare Gaming System (ENWGS)
	21. F-14D Training System
	22. F/A-18 Weapons Tactics Trainer
	23. Fleet Operations Simulation Project (FOSP)
	24. Helmet-Mounted Mission Rehearsal Simulation System (HMMRSS)
	25. Integrated Radar and Infrared Analysis and Modeling (IRIAM) System
	26. Integrated Theater Engagement Model (ITEM)
	27. Integrated Training Interface (ITI)
	28. Joint Countermine Operational Simulation (JCOS)
	29. Joint Combat Training Communications System (JCTCS)
	30. Joint Tactical Training System (JTTS)
	31. Landing Craft Air Cushion (LCAC) Full Mission Trainer
	32. Manned Flight Simulator (MFS)
	33. Mine Warfare Simulation Project
	34. Naval Air Battle Evaluation Model (NABEM II)
	35. Naval Simulation System (NSS)
	36. Research, Evaluation, and Systems Analysis (RESA)
	37. Space and Electronic Warfare Simulator (SEWSIM)
	38. SH-60F Helicopter Operational Flight Trainer/Weapons Systems
	39. Standard Missile (SM)
	40. Surface Cruiser 21 (SC-21)
	41. Tactical Advanced Combat Direction and Electronic Warfare Environmental Generation and Control System (TACDEW EGCS)
	42. Tactical Aircraft Mission Planning System (TAMPS)
	43. Target Acquisition (Targetacq)
	44. Tactical Team Trainer
	45. TEMPER (APL), EREPS, IREPS, RPO, and DCS
	46. Tomahawk Baseline Improvement Program (TBIP) Mission Planning Performance Prediction
	47. Tomahawk 6DOF Flight Simulation Model
	48. TRIDENT Command and Control Team Trainer
	49. Tropospheric Propagation Model

[1] ENWS and ENWGS, although having the same title, have been identified to have different atmospheric requirements. Tactical Training Group Pacific submitted the ENWS Requirements Questionnaire; Tactical Training Group Atlantic submitted the ENWGS Requirements Questionnaire.

Service or Agency	Titles of Models/Simulations
Navy: (continued)	50. V-22 Operational Flight Trainer **51. Weapons Analysis Facility (WAF)**
Marine Corps:	1. Advance Amphibious Assault Vehicle (AAAV) **2. Direct Forward Observer/Modular Universal Laser Engagement (DFO/MULE)** **3. Environmental Effects on Sensors (EES)** 4. Littoral Warfare Training Complex 5. MILES **6. MAGTF Tactical Warfare Simulator (MTWS)** **7. Maneuver Warfare Analytical Research System (MWARS)** **8. Team Target Engagement Simulator (TTES)**
Air Force:	**1. A/F 37A-T84 F-15 Weapon System Trainer** 2. Advanced Campaign Effectiveness (ACE) Model **3. Advanced Electro-optical Model for Aerial Targeting (AE*MAT)** 4. Advanced Low Altitude Radar Model (ALARM) 5. Air Combat Evaluation Model (ACEM) 6. Air-to-Air System Performance Evaluation Model (AASPEM) (Man-in-the-Loop Version) **7. Air Force Command Exercise System (ACES)** **8. Air Force Mission Support System (AFMSS)** **9. Air Warfare Simulation (AWSIM)** **10. BRAWLER** **11. COMBAT IV** **12. Contingency Theater Automated Planning System (CTAPS)** 13. Conventional Mating and Ranging Planning System (CMARPS) **14. C^2W Analysis and Simulation System (C^2WASS)** 15. Enhance Surface-to-Air Missile Simulation (ESAMS) 16. Extended Air Defense Simulation (EADSIM) 17. Fallout Assessment/Civilian Vulnerability Indicator Code (FAS/CIVIC) 18. Four Super Laboratories Modeling and Simulation for Science and Technology (FOURMOSST) Modeling and Simulation Catalog **19. Improved Many-on-Many (IMOM)** 20. Infrared Imaging Seeker II (IRIS II) 21. Joint Electronic Combat Electronic Warfare Simulation (JECEWSI) **22. Joint Modeling and Simulation System (J-MASS) Project** 23. Microcomputer Missile Performance Software (MPS) **24. Mission Environmental Requirements Integration Technology (MERIT)** 25. Mobility Analysis Support System (MASS) **26. Multiship Training Research Facility (MTRF)** **27. National Air and Space (Warfare) Model (NASM)**

Service or Agency	Titles of Models/Simulations
Air Force: (continued)	28. Radar-Directed Gun System Simulation (RADGUNS) 29. Rand Strategy Assessment System (RSAS) **30. Satellite Assessment Center (SATAC)** **31. SOF Aircrew Training System (ATS)/SOF Training & Rehearsal System (TARP)** **32. Space Surveillance Network Tracking Error (SSNTE) Model** 33. Spectral Infrared Imaging of Targets and Scenes (SPIRITS) 34. Strategic and Tactical Attack Modeling Process (STAMP) **35. SUPPRESSOR** 36. Theater Analysis (TAM) **37. Threat Engagement Model (TEAM)** **38. THUNDER** **39. Unit Training Device (UTD) for A-10, F-15, and F-16**
Advance Research Project Agency:	**1. Synthetic Theater of War (STOW)**
Coast Guard:	**1. Computer Assisted Search Planning (CASP)** **2. HH-60J Flight Trainer**

APPENDIX F

MODELS AND SIMULATIONS

IN THE

REQUIREMENTS SURVEY DATABASE

ARPA

E^2DIS Program Requirements Survey

M&S No.	03
M&S Title	Synthetic Theater of War (STOW)
M&S Description	The STOW program seeks to create a seamless simulated environment that will be usable across the spectrum of service and joint training, operations, doctrine development, and systems acquisition. It seeks to demonstrate the technologies to enable the integration of war-fighting headquarters with live instrumented simulation ranges, manned virtual simulators, and constructive simulations from diverse locations into a common synthetic battle space of the commander's choosing. The STOW Program is a logical development from the earlier ARPA-sponsored SIMNET and Aggregate Level Simulation Protocol Programs. STOW 97, an Advanced Concept Demonstration jointly sponsored by the ARPA and the US Atlantic Command, is a key milestone within the larger ARPA STOW program, which in turn is part of the Advanced Distributed Simulation Program.
Environmental Factors	None provided.
Organization	Applied Research Laboratory
Point of Contact	Mr. Eric White
Address–Line 1	University of Texas
Address–Line 2	PO Box 8029
Address–Line 3	Austin, TX 78713-8029
Phone Number	512 835-3621

Air Force

E^2DIS Program Requirements Survey

M&S No.	22
M&S Title	A/F37A-T84 F-15 Weapon System Trainer (WST)
M&S Description	Provides training to the pilot and the Weapon System Officer in both day and night flight to include normal and emergency aircraft and subsystems operations. Used to instruct crews on the proper use of offensive and defensive avionics system operations and weapon delivery. This includes use of the radar system, comm and nav systems, HUD, electronic warfare related systems, LANTIRN, and PGMs. Also used to instruct air-to-air and surface attack tactics as well as air refueling techniques.
Environmental Factors	Season, time of day, sun azimuth, and standard weather observations
Organization	OLAD
Point of Contact	Mr. Richard Lidie
Address–Line 1	29 TSS
Address–Line 2	7026 N 141 Ave.
Address–Line 3	Luke AFB, AZ 85309-1663
Phone Number	602 856-6009

Air Force

E^2DIS Program Requirements Survey

M&S No.	44
M&S Title	Advanced Electro-optical Model for Aerial Targeting (AE*MAT)
M&S Description	AEM*AT's aims are: to supply a common reference and tool for EO sensor developers, airframe and propulsion signature experts, vehicle designers, materials developers, electronic warfare designers, intelligence analysts, flight test engineers, scenario developers, weapons system planners, etc.; to create a repository and methodology for capturing new knowledge about EO aerial targeting as it is developed; and to provide a means for efficiently disseminating this information in a practical form to the communities of analysts, avionics and vehicle designers, contract specifiers, buyers, suppliers, old crows, operators, maintainers, strategists, and tacticians.
Environmental Factors	The driving and modulation of optical signatures of terrestrial backgrounds (terrain and water), sky backgrounds (cloud distribution and geometry of radiance distribution), horizon backgrounds, and viewing path (propagation and path radiance).
Organization	WL / AARI-1 B22
Point of Contact	William Lanich
Address–Line 1	ATTN.: W. A. Lanich
Address–Line 2	2690 C St., Suite 1
Address–Line 3	Wright-Patterson AFB, OH 45433-7408
Phone Number	513 255-5292
E-mail Address	lanichwa@aa.wpafb.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	25
M&S Title	Air Force Command Exercise System (ACES)
M&S Description	ACES is the major computer-based wargame used at the Air Force Wargaming Institute, which is tasked to plan, develop, and conduct wargames in support of USAF educational and operational requirements. ACES is an aggregated, theater-level wargame that focuses primarily in air campaign planning but also includes ground forces and aircraft carrier play.
Environmental Factors	A simple weather description: good, fair, poor, and very poor
Organization	CADRE/WGTD
Point of Contact	Capt Karl Mathias
Address–Line 1	Attn: Capt Karl Mathias
Address–Line 2	401 Chennalt Circle
Address–Line 3	Maxwell AFB, AL 36112-6428
Phone Number	205 953-5011
E-mail Address	mathias@afwc.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	62
M&S Title	Air Force Mission Support System (AFMSS)
M&S Description	AFMSS is a unit-level mission planning system whose purpose is to provide a semi-automated, mission planning capability for tactical, strategic, airlift, and rescue aircraft and their associated weapon systems. Current planning systems have been fielded for the F-117, F-15, F-16, F/RF-4, F/EF-111, and the B-1/B-52.
Environmental Factors	AFMSS has no capability to incorporate environmental data; nevertheless, "weather" obviously is normally part of the mission planning process.
Organization	Mission Planning Systems Office
Point of Contact	Capt Greg Best
Address–Line 1	ESC/YVD
Address–Line 2	5 Eglin St.
Address–Line 3	Hanscom AFB, MA 01731
Phone Number	617 377-7138
E-mail Address	best_greg@mps.hanscom.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	26
M&S Title	Air Warfare Simulation (AWSIM)
M&S Description	The AWSIM system is a near-real-time interactive simulation of the air and air defense warfare environment. AWSIM allows players from opposing sides to view the geographic movement of friendly and enemy air assets while also providing tabular information through video displays and selected hardcopy products.
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	USAFBTS/BTMPA
Point of Contact	Capt Walter Gartner
Address–Line 1	138 Hartson St.
Address–Line 2	Hurlburt Field, FL 32544-5231
Phone Number	904 884-7911
E-mail Address	gartner@auxnet.eglin.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	58
M&S Title	BRAWLER
M&S Description	The BRAWLER (formerly know as TAC BRAWLER) simulation is used by AFSAA as its primary air combat model. BRAWLER is a Monte Carlo event-driven computer simulation of a flight-versus-flight air combat engagement. Highly detailed sub-models emulate aircraft performance, avionics, and air-to-air missiles. BRAWLER will be replaced by an object oriented model compatible with the J-MASS architecture.
Environmental Factors	None, weather plays only an indirect role in that the effect of clouds is inferred by a reduction of the distance a pilot can see. There is no input of environmental data.
Organization	AFSAA/SAGW
Point of Contact	Major Al Gracia
Address–Line 1	1570 Air Force Pentagon
Address–Line 2	Washington, DC 20330-1570
Phone Number	703 697-5677

Air Force

E^2DIS Program Requirements Survey

M&S No.	19
M&S Title	C2W Analysis and Simulation System (C2WASS)
M&S Description	Incorporates several models and/or simulators that span the complete electronic warfare infrastructure architecture to include integrated air defense systems, telecommunications, space, transportation, logistics, etc.
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	AFIWC/SAA
Point of Contact	Lt Col Richard Snook
Address–Line 1	Suite 338
Address–Line 2	102 Hall Blvd.
Address–Line 3	San Antonio, TX 78243-7020
Phone Number	210 977-2427

Air Force

E^2DIS Program Requirements Survey

M&S No.	61
M&S Title	COMBAT IV
M&S Description	The COMBAT IV Model is a theater region level simulation of air and ground combat in a conventional, chemical, and/or nuclear environment. It is a fully automated, time-stepped, deterministic, two-sided simulation of air and ground combat at the theater region level. Fully integrated conventional, chemical, and nuclear operations by air and ground forces can be simulated.
Environmental Factors	COMBAT IV has no critical environmental issues; it makes no use of atmospheric or near space data.
Organization	ACC Studies and Analysis Sq.
Point of Contact	Mr. Phil Thayer
Address–Line 1	204 Dodd Blvd, Ste 202
Address–Line 2	Langley AFB, VA 23665-2778
Phone Number	804 764-7227

Air Force

E^2DIS Program Requirements Survey

M&S No.	63
M&S Title	Contingency Theater Automated Planning System (CTAPS)
M&S Description	CTAPS is the airbattle planning and execution system used by JFACC/Staff at the Air Ops Center to generate and disseminate the ATO. (Note that CTAPS is a C2 system, not a model or simulation.)
Environmental Factors	CTAPS needs to consider IR data and other atmospheric conditions that affect route planning and targeting.
Organization	ESC/AVB
Point of Contact	Col Carl Steiling
Address–Line 1	20 Schilling Circle
Address–Line 2	Hanscom AFB, MA 01731
Phone Number	617 271-8182

Air Force

E^2DIS Program Requirements Survey

M&S No.	20
M&S Title	Improved Many-on-Many (IMOM)
M&S Description	IMOM can analyze and graphically display an electronic warfare environment conditioned by the effects of electronic countermeasures. It shows the effects of terrain masking and accounts for weapon systems capabilities.
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	AFIWC/SAM
Point of Contact	Mr. Rod Peltier
Address–Line 1	Suite 343
Address–Line 2	102 Hall Blvd.
Address–Line 3	San Antonio, TX 78243-7020
Phone Number	210 977-7547

Air Force

E^2DIS Program Requirements Survey

M&S No.	57
M&S Title	Joint Modeling and Simulation System (J-MASS) Project
M&S Description	J-MASS is a modeling and simulation system that provides a software architecture for the development, execution, and postprocessing of simulations. Also, it implements a set of standards by providing tools that assist in the development and application of reusable models and model components. Recent investigations have provided functional J-MASS prototypes of an IR Environment, IR Jammer, and a Distributed Interactive Simulation interface.
Environmental Factors	RF electromagnetic propagation
Organization	ASC/XREM
Point of Contact	Mr. Art Daum
Address–Line 1	2145 Monohan Way
Address–Line 2	Bldg. 28
Address–Line 3	Wright-Patterson AFB, OH 45433
Phone Number	513 255-3969
E-mail Address	dauma@rerw.wpafb.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	43
M&S Title	Mission Environmental Requirements Integration Technology (MERIT)
M&S Description	The MERIT program objective is to develop and demonstrate a workstation-based expert system to aid environmental engineers in developing environmental life-cycle profiles during the conceptual phase of the material acquisition process.
Environmental Factors	The magnitude and duration of all environmental elements that affect the weapon system during its lifecycle profile.
Organization	Aeronautical Systems
Point of Contact	Capt Steven Fiorino
Address–Line 1	WL / DOWF
Address–Line 2	2130 Eighth St., Suite 1
Address–Line 3	Wright-Patterson AFB, OH 45433-7542
Phone Number	513 255-5496
E-mail Address	fiorinst@wl.apafb.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	24
M&S Title	Multiship Training Research Facility (MTRF)
M&S Description	The Multiship Training Research and Development (MULTIRAD) project is to demonstrate and evaluate simulation technologies and training strategies that will allow the Combat Air Forces access to the synthetic combat environments of the 21st century.
Environmental Factors	Air density, visibility, and clouds, haze, fog, smoke, etc. that affect IR transmission
Organization	Armstrong Laboratory
Point of Contact	Mr. Steve Stephens
Address–Line 1	Aircrew Training Research Div
Address–Line 2	6001 S. Power Rd., Bldg 558
Address–Line 3	Mesa, AZ 8524-0904
Phone Number	602 988-6561
E-mail Address	simguy@hrlban1.aircrew.asu.edu

Air Force

E^2DIS Program Requirements Survey

M&S No.	56
M&S Title	National Air and Space [Warfare] Model (NASM)
M&S Description	When developed as AWSIM's replacement, NASM will be a simulated, distributed system that provides an air/space model that will meet the operational needs of the USAF. NASM will provide the functional capability to realistically represent the full range of aerospace power applications (including supporting functionalities such as logistics, intelligence, medical, engineering, communications, geophysical, meteorological, space, environmental factors, information warfare, and electronic warfare) for both Air Force-specific and joint training.
Environmental Factors	Weather as it affects air operations and the mission space (e.g., smoke, fog, biological and chemical weaponry); electromagnetic, optic, and acoustic propagation.
Organization	ESC/AVMW(PTI)
Point of Contact	Mr. Tim Rudolph
Address–Line 1	20 Schilling Circle
Address–Line 2	Hanscom AFB, MA 01731-2816
Phone Number	617 377-6434
E-mail Address	rudolpht@wg.hanscom.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	23
M&S Title	SOF Aircrew Training System (ATS) / SOF Training and Rehearsal Program (TARP)
M&S Description	Rehearse MC-130 E/H missions 48+ hours beforehand, in a virtual environment for strategic and tactical planning.
Environmental Factors	Pressure, wind velocity, temperature, humidity, and precipitation
Organization	ASC-YTE
Point of Contact	Mr. Tim Dwyer
Address–Line 1	Training System SPO
Address–Line 2	Wright-Patterson AFB, OH 45433-6503
Phone Number	513 255-8926
E-mail Address	dwywetm@asc-yt.wpafb.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	60
M&S Title	SUPPRESSOR
M&S Description	SUPPRESSOR is an analytic model that simulates a possibly multisided conflict involving some combination of air, ground, naval, and space-based systems. SUPPRESSOR is sensitive to a wide range of parameters, including speeds, altitude, signature, sensors, weapons, tactics, communications, ECM, rules of engagement, resources, and the environment (not, however, specific atmospheric or space data types). All these sensitivities influence the outcome of a scenario.
Environmental Factors	SUPPRESSOR has no critical environmental issues now; it makes no use of atmospheric or near space data. The areas modeled, however, suggest that it has the potential to use several types.
Organization	Modeling, Analysis, and Simulations Ctr.
Point of Contact	Mr. Wally Wallace
Address–Line 1	ESC/XRPM
Address–Line 2	50 Griffiss St.
Address–Line 3	Hanscom AFB, MA 01731-1624
Phone Number	617 377-5535
E-mail Address	gibsonn@tango-vs1.hanscom.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	27
M&S Title	Satellite Assessment Center (SATAC)
M&S Description	Model and analyze the effects of (nuclear, RF/HPM, and KEW) weapons on satellites.
Environmental Factors	Magnetic fields, atmospheric constituents, and ionospheric composition.
Organization	SATAC
Point of Contact	Mr. Patrick McDaniel
Address–Line 1	Bldg. 914, Room 228
Address–Line 2	3550 Aberdeen Ave., SE
Address–Line 3	Kirtland AFB, NM 87117-5776
Phone Number	505 846-4353

Air Force

E^2DIS Program Requirements Survey

M&S No.	52
M&S Title	Space Surveillance Network (SSN) Tracking Error (TE) Model
M&S Description	This model is being developed to simulate the various sources of error in the measurement of satellite positions from ground-based sensor sites. These calibration errors can result from inaccurate knowledge of the site location, errors in coordinate transformations due to approximations in polar motion, earth rotation rate, precession, nutation, etc., and errors due to atmospheric refraction.
Environmental Factors	The refractive effects of the troposphere and ionosphere on radar tracking observations.
Organization	Space Warfare Center/SAA
Point of Contact	Mr. Mark Storz
Address–Line 1	730 Irwin Ave.
Address–Line 2	Falcon AFB, CO 80912-7300
Phone Number	719 380-3550
E-mail Address	storzmf@fafb.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	55
M&S Title	THUNDER
M&S Description	THUNDER is the Air Force's principle two-sided, theater level model simulating conventional air-land combat. THUNDER is used to assess, evaluate or compare the contribution of the air campaign to the combat outcome at the theater level. THUNDER is being used to evaluate force structure, deployment, and employment alternatives as well as supporting the requirements definition for future acquisition programs. THUNDER simulates combat operations for multiple day scenarios and dynamically plans the air and ground operations as targets are destroyed and campaign objectives change. THUNDER dynamically models; day/night operations; sortie availability; target sets and priorities; weather; combat engagements for aircraft; and ground employment.
Environmental Factors	At HIGH resolution, the user provides the weather forecasts (ceilings and visibilities) for planning air missions and weather data for modeling missions. At LOW resolution, THUNDER assumes perfect weather with infinite ceiling and visibility.
Organization	Air Force Studies and Analysis Agency
Point of Contact	Major Venton Duncan
Address–Line 1	AFSAA/SAG
Address–Line 2	1570 Air Force Pentagon
Address–Line 3	Washington, DC 20330-1570
Phone Number	703 697-5616
E-mail Address	duncan@afsaa.hq.af.mil

Air Force

E^2DIS Program Requirements Survey

M&S No.	21
M&S Title	Threat Engagement Analysis Model (TEAM)
M&S Description	TEAM simulates an engagement between a single threat missile and a single target aircraft equipped with electronic counter measures (ECM). TEAM provides 3-dimensional animated graphics views of all aspects of this one-to-one engagement. In TEAM an air-to-air or surface-to-surface missile is launched at a maneuvering target aircraft equipped with chaff, flares, and a missile warning system. Systems are modeled so that accurate ECM/ECCM analyses can be performed.
Environmental Factors	Air density, pressure, local speed of sound, atmospheric attenuation of R/EO/RF signals, and scattering of UV/EO signals
Organization	AFIWC/SAC
Point of Contact	Mr. Jimmy Washington
Address–Line 1	Suite 342
Address–Line 2	102 Hall Blvd.
Address–Line 3	San Antonio, TX 78243-7020
Phone Number	210 977-2391

Air Force

E^2DIS Program Requirements Survey

M&S No.	28
M&S Title	Unit Training Device (UTD) for A-10, F-15 and F-16
M&S Description	Initial and continuation training for instruments, emergency procedures, and tactics.
Environmental Factors	Cloud cover, wind, visibility, ground buildup (i.e., roughness), light, and adverse weather
Organization	NGB/AQP
Point of Contact	Major Mike Miller
Address–Line 1	2500 Army Pentagon
Address–Line 2	Washington, DC 20310-2500
Phone Number	703 614-0188
E-mail Address	m=miller%aq%ngbp@angrc.ang.af.mil

Army

E^2DIS Program Requirements Survey

M&S No.	10
M&S Title	Battlefield Environment Weapon System Simulation (BEWSS)
M&S Description	The BEWSS is an all-digital constructive simulation that addresses the performance/effectiveness of advanced weapon systems, sensors, and concepts in the presence of the dirty battlefield environment. The effects of the dirty battlefield on system operation and performance are addressed via high resolution terrain models, obscurant models (developed in-house), and high fidelity validated models for atmospheric propagation and radiation, such as EOSAEL87 and LOWTRAN7.
Environmental Factors	Transmission of communication, guidance, and target signatures at all spectral bandwidths within the tactical battle areas. Also, scintillation, beam spread, image distortion, and scatter and beam wander for various sensors and receivers.
Organization	U.S. Missile Command
Point of Contact	Mr. Robert Alongi
Address–Line 1	AMSMI-RD-AA (R. Alongi)
Address–Line 2	Redstone Arsenal, AL 35898
Phone Number	205 876-2961
E-mail Address	alongi@redstone-emh2.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	13
M&S Title	Camouflage Multispectral Engineering Library and Analysis Station (CAMELIAN)
M&S Description	The CAMELIAN environment is a set of analysis tools used for the exploitative modification and enhancement of physical signatures (visual, infrared, and radar) and engineering (e.g., structure and materials). CAMELIAN employs both commercial- and DoD-developed/validated models for the design and evaluation of CCD countermeasures, which are needed to improve the survivability and operability of fixed facilities against multispectral airborne target acquisition systems.
Environmental Factors	Low level state of the atmosphere
Organization	USAE Waterways Experiment Station
Point of Contact	Mr. Gerardo Velazquez
Address–Line 1	Attn: CEWES-SS-C
Address–Line 2	3909 Halls Ferry Road
Address–Line 3	Vicksburg, MS 39180-6199
Phone Number	601 634-3265
E-mail Address	gerardo@c2d2e2.wes.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	08
M&S Title	Combined Arms and Support Task Force Evaluation Model (CASTFOREM)
M&S Description	A fully automated, high resolution combat simulation model representing a combined arms conflict up to and including brigade level. Includes fire support, air (limited fixed-wing), air defense, and engineering operations. TACTIW are implemented via an embedded expert system using decision tables. The model is event driven and stochastic.
Environmental Factors	Atmospheric and obscurant extinction coefficients for seven spectral regions.
Organization	Dir TRADOC Analysis Center
Point of Contact	Mr. Douglas Mackey
Address–Line 1	Attn: ATRC-WEB (Mr. Mackey)
Address–Line 2	White Sands Missile Range
Address–Line 3	WSMR, NM 88002-5502
Phone Number	505 678-4715

Army

E^2DIS Program Requirements Survey

M&S No.	06
M&S Title	Communications-on-the-Move Radio Model (CMRM)
M&S Description	Supports tactical communications for corps and below in the digital battlefield.
Environmental Factors	Meteorological and atmospheric effects on communications in the 10-MHz to the 10-GHz frequency range.
Organization	CECOM
Point of Contact	Mr. K. Brockel
Address–Line 1	Space & Terrestrial Comm Div
Address–Line 2	AMSEL-RD-ST-CE
Address–Line 3	Fort Monmouth, NJ 07703
Phone Number	908 544-3479
E-mail Address	brockel%doim6@monmouth-emh3.ar

Army

E^2DIS Program Requirements Survey

M&S No.	05
M&S Title	Dynamic Ground Target Simulator (DGTS)
M&S Description	Referenced attached description was not available
Environmental Factors	Factors that affect radio frequency (RF) path loss, such as atmospheric refractivity, humidity, ground conductivity, and magnetic permeability.
Organization	IEWD, CECOM
Point of Contact	Ismael Rivera
Address–Line 1	Attn: AMSEL-RD-IEW-TA-M
Address–Line 2	Fort Monmouth, NJ 07703
Phone Number	908 544-2085

Army

E²DIS Program Requirements Survey

M&S No.	59
M&S Title	EADSIM (Extended Air Defense Simulation)
M&S Description	EADSIM is an analytic model of air and missile warfare used for scenarios ranging from few-on-few to many-on-many. It is unique in that each platform (such as fighter aircraft) is individually modeled, as is the interaction among platforms. It models Command and Control (C2) decision processes and the communications among the platforms on a message-by-message basis. Intelligence gathering is explicitly modeled and the intelligence information is used in both offensive and defensive operations.
Environmental Factors	EADSIM has no critical environmental issues now; it makes no use of atmospheric or near space data. The areas modeled, however, suggest that it has the potential to use several types (see table PREQDATA.DB).
Organization	Modeling, Analysis, and Simulations Ctr.
Point of Contact	Mr. Wally Wallace
Address–Line 1	ESC/XRPM
Address–Line 2	50 Griffiss St.
Address–Line 3	Hanscom AFB, MA 01731-1624
Phone Number	617 377-5535
E-mail Address	gibsonn@tango-vs1.hanscom.af.mil

Army

E^2DIS Program Requirements Survey

M&S No.	45
M&S Title	FOX Vehicle and CB/Smoke Atmospheric Models
M&S Description	FOX vehicle platform for developmental sensors, CB/smoke atmospheric models, and CB effects into JANUS-A (constructive).
Environmental Factors	Transport and diffusion of CB and smoke particulates, and how these affect sensors
Organization	U.S. Army, ERDEC
Point of Contact	Dr. John White
Address–Line 1	SCBRD - RTM
Address–Line 2	Aberdeen Proving Grounds, MD 21010
Phone Number	410 671-4256
E-mail Address	jrwhite@cbdc9.apgea.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	04
M&S Title	Integrated Unit Simulation System (IUSS)
M&S Description	IUSS is an analysis tool to assess Soldier System equipment and tactics/operations for dismounted infantry issues. Using ARTEP-Based Missions, a task network is constructed for squad/platoon entities to comply with the OPORD.
Environmental Factors	Atmosphere as it relates to heat stress; chemical, biological, nuclear, and convention munition dissemination. Near space: none.
Organization	US Army Natick RDE Center
Point of Contact	Mr. John O'Keefe
Address–Line 1	Attn: SATNC-AA
Address–Line 2	Kansas Street
Address–Line 3	Natick, MA 01760-5015
Phone Number	508 651-4881

Army

E^2DIS Program Requirements Survey

M&S No.	12
M&S Title	Logistics Over the Shore Site Selection (LOSSS)
M&S Description	Interactive software that allows planners to determine location and time (season) for LOTS operations based on hindcasted wave data, water level, current, and beach characteristics data.
Environmental Factors	Bathymetry, sea state, water levels, winds, and currents
Organization	USAE Waterways Experiment Station
Point of Contact	Mr. Steve Bratos
Address–Line 1	3909 Halls Ferry Road
Address–Line 2	Attn: CEWES-CR-O
Address–Line 3	Vicksburg, MS 39180-6199
Phone Number	601 634-4230
E-mail Address	bratos@larry.wes.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	16
M&S Title	Logistics Over the Shore Throughput Planner (LOTSTP)
M&S Description	Not provided
Environmental Factors	Bathymetry, sea state, surf state, water level, and wind
Organization	USAE Waterways Experiment Station
Point of Contact	Mr. Frank Sargent
Address–Line 1	Attn: CEWES-CW-N
Address–Line 2	3909 Halls Ferry Road
Address–Line 3	Vicksburg, MS 39180-6199
Phone Number	601 634-3586
E-mail Address	sargent@admiral.wes.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	11
M&S Title	Mounted Warfare Test Bed (MWTB)
M&S Description	The MWTB, as part of the DIS Network, is fashioned to provide mounted-ground-maneuver-based, force-on-force, man-in-the-loop, investigative environment to assess combat and material developments in operational conditions too expensive, too technically complex, too manpower intensive, or unsafe for field testing. Activities range from crew- to brigade-level operations.
Environmental Factors	Day/night operations; fog/rain/dawn-to-dusk/flare operations; thermal imagery impacted by the atmosphere
Organization	TOR - Knox
Point of Contact	Dr. Ken Hunt
Address–Line 1	PO Box 89
Address–Line 2	2021 Black Horse Regiment Ave.
Address–Line 3	Fort Knox, KY 40121-0089
Phone Number	502 942-1092

Army

E^2DIS Program Requirements Survey

M&S No.	14
M&S Title	NATO Reference Mobility Model - II (NHRMM II)
M&S Description	The purpose of NRMM II is to provide on-road and off-road mobility predictions for ground vehicles in real world areas or artificial terrain or road units. The performance data can then be used to evaluate vehicle performance, compare vehicle performance, develop vehicle specifications for acquisition programs, or develop tactical decision aids.
Environmental Factors	Precipitation, temperature, and obscurants
Organization	USAE Waterways Experiment Station
Point of Contact	Mr. Donald Randolph
Address–Line 1	3909 Halls Ferry Road
Address–Line 2	Vicksburg, MS 39180
Phone Number	601 634-2694
E-mail Address	randolf@ex1.wes.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	09
M&S Title	Night on BDS / Paint the Night (NBDS/PN)
M&S Description	Create interactive, physics-based synthetic FLIR imagery with near-horizontal viewing angles at ranges of 1 to 10 km. The primary purpose is to model the acquisition problem.
Environmental Factors	Transmissivity, path radiance, and turbulence
Organization	Night Vision Directorate
Point of Contact	Mr. Sander Der
Address–Line 1	AMSEL-RD-NV-VISP (Sander Der)
Address–Line 2	10221 Burbeck Rd., Suite 430
Address–Line 3	Fort Belvior, VA 22060-5860
Phone Number	703 704-3230
E-mail Address	none

Army

E^2DIS Program Requirements Survey

M&S No.	07
M&S Title	SINCGARS
M&S Description	The SINCGARS radio model provides realistic voice and data communications in a DIS environment. Line-of-sight, path loss, and propagation effects are modeled to facilitate realistic communications performance over DSI.
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	CECOM RDEC C2SID
Point of Contact	Mr. Larry Goldberg
Address–Line 1	AMSEL-RD-C2-CA
Address–Line 2	Fort Monmouth, NJ 07703
Phone Number	908 544-2837

Army

E^2DIS Program Requirements Survey

M&S No.	15
M&S Title	Terrain Evaluation Module (TEM)
M&S Description	TEM is an evolutionary prototype that will become Army Command and Control System (ATCCS) common software. TEM enables commanders and staff to perform superior, in-depth evaluation of the terrain in their areas of operation.
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	USAE Waterways Experiment Station
Point of Contact	Mr. T. Falls
Address–Line 1	Attn: CEWES-C-M-L
Address–Line 2	3909 Halls Ferry Road
Address–Line 3	Vicksburg, MS 39180-6199
Phone Number	601 634-4015
E-mail Address	h3gmltf0@gml690.wes.army.mil

Army

E^{2}DIS Program Requirements Survey

M&S No.	17
M&S Title	Transportation Infrastructure Assessment (TIA)
M&S Description	Describe and evaluate (in civil engineering terms) the transportation infrastructure (roads, airfields, rails, ports, logistics-over-the-shore [LOTS], inland waterways) within selected theaters of operation.
Environmental Factors	Precipitation, temperature, fog, and cloud cover
Organization	Mobility Systems Division
Point of Contact	Mr. Conrad Rabalais
Address–Line 1	Attn: CEWES-GM-K
Address–Line 2	3909 Halls Ferry Road
Address–Line 3	Vicksburg, MS 39180-6199
Phone Number	601 634-3925
E-mail Address	h3gmmer0@apollo.wes.army.mil

Army

E^2DIS Program Requirements Survey

M&S No.	46
M&S Title	WARSIM 2000 (War Fighter Simulation 2000)
M&S Description	Provide warfighters with simulation tools they can use to create realistic conditions for training Commanders and Battle Staffs to win the information war.
Environmental Factors	Unidentified (WARSIM 2000 is in the early phase of development) factors that affect communications and sensors.
Organization	USA Material Systems Analyst Activity
Point of Contact	Mr. Richard Sandmeyer
Address–Line 1	Director, US AMSAA
Address–Line 2	AMXSY-CD (Attn: R. Sandmeyer)
Address–Line 3	Aberdeen Proving Grounds, MD 21005-5071
Phone Number	410 278-5328
E-mail Address	richsand@arl.mil (or richsand@brl.mil)

Coast Guard

E^2DIS Program Requirements Survey

M&S No.	65
M&S Title	Computer Assisted Search Planning (CASP)
M&S Description	CASP is a Monte Carlo simulation technique that models the behavior of up to 20,000 simulated targets using a different, randomly-drawn set of factors for each. Factors include, but are not limited to, the initial position distribution in space and time, incident time, incident location, wind, sea current, leeway, and search craft performance.
Environmental Factors	CASP is concerned with surface ocean currents; hence, the low-level vector wind is important.
Organization	US Coast Guard
Point of Contact	LCDR Dale Streyle
Address–Line 1	Operation Systems Center (OSC)
Address–Line 2	20 Murall Drive
Address–Line 3	Martinsburg, WV 25401
Phone Number	304 264-2555

Coast Guard

E^2DIS Program Requirements Survey

M&S No.	66
M&S Title	HH-60J Flight Trainer
M&S Description	The HH-60J Flight Trainer provides transitional and recurrent training of US Coast Guard pilots for all-weather search and rescue missions.
Environmental Factors	Impact on aircraft systems operations and flight characteristics
Organization	NAWCTSA
Point of Contact	Mr. Frank Frey
Address–Line 1	Code 4921
Address–Line 2	12350 Research Parkway
Address–Line 3	Orlando, FL 32826-3224
Phone Number	407 380-4119
E-mail Address	frank_frey@ntsc.navy.mil

Marine Corps

E^2DIS Program Requirements Survey

M&S No.	47
M&S Title	DFO/MULE
M&S Description	Train forward observers and FACs in the use of laser designators and the control of fires. The simulator accounts for movement and observation of targets, and the timing of the application of fires.
Environmental Factors	Visibility of targets, signal attenuation of laser designator beam, and realistic backgrounds for targets
Organization	MARCOR SYSCOM (AW)
Point of Contact	Maj Frank Wysocki
Address–Line 1	Barnett Ave. Suite
Address–Line 2	Quantico, VA 22134
Phone Number	703 640-4788
E-mail Address	wysockif@mqgz.usmc.mil

Marine Corps

E^2DIS Program Requirements Survey

M&S No.	48
M&S Title	Environmental Effects on Sensors (EES)
M&S Description	Simulate the environment in which a sensor must perform.
Environmental Factors	Unidentified atmospheric effects to a height of 2000 m
Organization	MARCOR SYSCOM (AW)
Point of Contact	Maj Frank Wysocki
Address–Line 1	Barnett Ave. Suite
Address–Line 2	Quantico, VA 22134
Phone Number	703 640-4788
E-mail Address	wysockif@mqgz.usmc.mil

Marine Corps

E^2DIS Program Requirements Survey

M&S No.	64
M&S Title	MAGTF Tactical Warfare Simulator (MTWS)
M&S Description	MTWS is an advanced Tactical combat simulator designed as a decision support system in real and constructive environments to augment Marine Corps Command and Control Systems. As a developmental replacement for the Tactical Warfare Simulation Evaluation and Analysis System (TWSEAS), MTWS will provide interactive, multisided, force-on-force, real-time modeling and simulation for stand-alone tactical combat scenarios for air, ground, surface, and amphibious operations.
Environmental Factors	The MTWS is concerned about the effect of precipitation on visibility and trafficability. Also the sea state's effect on mobility and stability of landing craft, and the terrain's effect on line-of-sight detection of targets.
Organization	Commanding Officer
Point of Contact	Mr. John Chang
Address–Line 1	NCCOSC RDTE Division
Address–Line 2	53560 Hull St.
Address–Line 3	San Diego, CA 92152-5001
Phone Number	619 553-1697
E-mail Address	jychang@nosc.mil

Marine Corps

E^2DIS Program Requirements Survey

M&S No.	02
M&S Title	Maneuver-Warfare Analytical Research System (MWARS)
M&S Description	The Center for Naval Analysis is developing a model of maneuver warfare called the MWARS, which is sponsored by the Marine Corp (MCCDC) and the Navy (N8). The model is an analytical tool to help develop and validate maneuver-warfare doctrine, and for use in cost and operational effectiveness analyses (COESs). The primary focus of MWARS is the amphibious assault. A typical size for a friendly force in MWARS is an Amphibious Ready Group (ARG) with a MEF-forward embarked.
Environmental Factors	Those factors affecting visibility and IR/EO detection; weather, primarily precipitation; sun and moon position.
Organization	The Center for Naval Analysis
Point of Contact	Dr. John Parsons
Address–Line 1	4401 Ford Ave.
Address–Line 2	Alexandria, VA 22302-0268
Phone Number	703 824-2000

Marine Corps

E^2DIS Program Requirements Survey

M&S No.	49
M&S Title	Team Target Engagement Simulator (TTES)
M&S Description	Provide a deployed reinforced rifle squad with the capabilities to train in tactics and marksmanship for urban conflict.
Environmental Factors	Line-of-sight airborne effluents
Organization	NAWCTSD
Point of Contact	David Fowlkes
Address–Line 1	Code 261
Address–Line 2	12350 Research Parkway
Address–Line 3	Orlando, FL 32792
Phone Number	407 380-4789
E-mail Address	fowlkes@ntsc-rd.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	69
M&S Title	AEGIS Radar System Controller Environmental Simulation (RSCES)
M&S Description	The purpose is to simulate the AN-SPY-1B/D radar performance with simulated environments (sea; volume and clutter).
Environmental Factors	Response of radar to rain and clouds
Organization	Lockheed Martin Marietta
Point of Contact	Mr. Frank Alessandro
Address–Line 1	Lockheed Martin Corp.
Address–Line 2	Moorestown, NJ
Phone Number	609 722-2178

Navy

E²DIS Program Requirements Survey

M&S No.	68
M&S Title	AEGIS AN/SPY-1A/B/D Firm Track Simulation
M&S Description	The purpose is to estimate the firm track range performance of SPY-1 radars in various environments and tactical situations.
Environmental Factors	Refractive conditions, proximity to land and associated terrain characteristics, and vector wind
Organization	Johns Hopkins University
Point of Contact	Mr. Gerald Konstanzer
Address–Line 1	Applied Physics Laboratory
Address–Line 2	Johns Hopkins Rd.
Address–Line 3	Laurel, MD 20723
Phone Number	301 953-6000

Navy

E^2DIS Program Requirements Survey

M&S No.	33
M&S Title	Chemical / Biological / Agent Vapor, Liquid, and Solid Tracking (VLSTRACK)
M&S Description	VLSTRACK is a user-friendly computer model that provides approximate chemical and biological warfare hazard predictions for a wide range of chemical munitions and biological agents of military interest.
Environmental Factors	Atmospheric transport and diffusion
Organization	Naval Surface Warfare Center
Point of Contact	Mr. Timothy Bauer
Address–Line 1	Dahlgren Division, Code B51
Address–Line 2	17320 Dahlgren Rd.
Address–Line 3	Dahlgren, VA 22448-5100
Phone Number	703 663-8621

Navy

E^2DIS Program Requirements Survey

M&S No.	36
M&S Title	Combat System Engineering and Analysis System (CSEAL) Simulation System (CSS)
M&S Description	CSS provides a simulation of "the world" as viewed by a submarine. The simulation can take place anywhere in the world, engaging any number of airborne, surface, or subsurface contacts. All onboard and offboard sensors, weapons, and nav are simulated. These data are used to stimulate submarine adm's being developed in the CSEAL environment.
Environmental Factors	Unidentified parameters for standard Navy EO models.
Organization	Naval Undersea Warfare Center
Point of Contact	Mr. Donald Caron
Address–Line 1	Division Newport
Address–Line 2	Code 2223, Bldg 1171/3
Address–Line 3	Newport, RI 02841
Phone Number	401 841-3616
E-mail Address	caron@iris-15.ada.npt.nuwc.navy.mil

Navy

E^{2}DIS Program Requirements Survey

M&S No.	39
M&S Title	Combat Systems Multi-Warfare Tactical Scenarios (CSMWTS)
M&S Description	Provide Condition II watch stander and watch team training in multi-warfare naval operations. The primary mission areas are: AAW, ASW, ASUW, ELW, C3, STK, and Intel. Scenarios are developed to be run/controlled by a ship's combat systems training team (CSTT).
Environmental Factors	CSTT-generated IREPS data for radar and emitter detection and prediction ranges; ocean environmental data for ASW range predictions.
Organization	Curriculum/Scenario Development Dept
Point of Contact	CDR T. Bennett
Address–Line 1	AFLOAT Training Group Atlantic
Address–Line 2	8952 First St., Suite 121
Address–Line 3	Norfolk, VA 23511-3786
Phone Number	804 445-0962

Navy

E^{2}DIS Program Requirements Survey

M&S No.	67
M&S Title	Composite Warfare Model (CWM) 3.4.0
M&S Description	The CWM model is a quantitative, Monte Carlo simulation and assessment for end-to-end (i.e., sensor-to-shooter) analysis and assessment of joint mission area (JMA) and warfare task area concepts and systems in regional multiwarfare operational and tactical situations. The model permits detailed assessment of surveillance, battle management, C4I architectures, decision rules/tactical doctrine, and battle management schemes. It is also used in comparative tradeoff studies.
Environmental Factors	CWM must consider day/night restrictions on using sensors and the effects of cloud cover on space-based, airborne, and surface-based sensors.
Organization	Space & Naval Warfare Systems Command
Point of Contact	Dr. Jerry Hoffman
Address–Line 1	SPAWAR 311-4
Address–Line 2	2451 Crystal Drive, Crys Pk 5
Address–Line 3	Arlington, VA 22245-5200
Phone Number	703 332-5891
E-mail Address	drhoffman@smtp-gw.spawar.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	70
M&S Title	Cruise Missile Mission Planning and Weapon Control Systems: Tomahawk Land Attack Missile (TLAM)
M&S Description	None provided.
Environmental Factors	The TLAM must account for the timeliness and accuracy of meteorological and oceanographic (METOC) parameters that affect missile performance. These parameters were not identified.
Organization	Johns Hopkins University
Point of Contact	Dr. Richard Giannola
Address–Line 1	Applied Physics Laboratory
Address–Line 2	Johns Hopkins Rd.
Address–Line 3	Laurel, MD 20723-6099
Phone Number	301 953-6000
E-mail Address	richard.giannola@jhuapl.edu

Navy

E^2DIS Program Requirements Survey

M&S No.	35
M&S Title	Enhanced Naval Warfare Gaming System (ENWGS)
M&S Description	With about 500,000 lines of code and 500,000 database elements, ENWGS is used to simulate US Naval Tactical Warfare and US Naval Operational Art.
Environmental Factors	Atmospheric characteristics, full electromagnetic spectrum attenuation, and dynamic weather.
Organization	TACTRAGRUPAC
Point of Contact	Mr. William Cooper
Address–Line 1	53720 Horizon Drive
Address–Line 3	San Diego, CA 92147
Phone Number	619 553-8352
E-mail Address	wcooper@nosc.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	41
M&S Title	Enhanced Naval Wargaming System (ENWS)
M&S Description	Joint wargaming from unit to strategic level
Environmental Factors	Obstructions to vision (clouds, fog, haze, precipitation), density (radar trapping or ducting), sunrise and sunset, sea state, and wind velocity.
Organization	Tactical Training Group Atlantic
Point of Contact	Mr. Ken Werhan
Address–Line 1	2132 Regulus Ave.
Address–Line 2	Virginia Beach, VA 23461-2199
Phone Number	804 433-7806

Navy

E^2DIS Program Requirements Survey

M&S No.	71
M&S Title	F-14D Training System
M&S Description	The F-14D Training System provides transition and recurrent training to aircrews in basic flight and tactical operations.
Environmental Factors	The environmental impact on sensors and weapon system delivery as well as aircraft systems operations and flight characteristics.
Organization	NAWCTSA
Point of Contact	Mr. Dan Schab
Address–Line 1	Code 4921
Address–Line 2	12350 Research Parkway
Address–Line 3	Orlando, FL 32826-3224
Phone Number	407 380-4665
E-mail Address	dan_schab@ntsc.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	37
M&S Title	Helmet-Mounted Mission Rehearsal Simulation System (HMMRSS)
M&S Description	Mission rehearsal planning
Environmental Factors	Accuracy and timeliness
Organization	Naval Air Systems Command
Point of Contact	CDR Micheline Eyraud
Address–Line 1	Code Air 05C3
Address–Line 2	1421 Jefferson Davis Hwy.
Address–Line 3	Arlington, VA 22243
Phone Number	703 604-2080
E-mail Address	eyraudmy@ntrprs.navy.mil

Navy

E^{2}DIS Program Requirements Survey

M&S No.	38
M&S Title	Integrated Radar and Infrared Analysis and Modeling (IRIAM) System
M&S Description	IRIAM is a modular system designed to provide users with an integrated core of hardware and software modules and other advanced technology features. IRIAM will serve as a testbed for DoD-approved Electro-Optical and Infrared (EOIR) signature databases and models, providing both electro-optical and radar modeling in a coupled suite of codes.
Environmental Factors	Atmospheric effects on the propagation of IR, visible, millimeter wave (MMW), UV, and radar energy.
Organization	Commander (Code P22305)
Point of Contact	Dr. Eric DeJong
Address–Line 1	Naval Air Warfare Center
Address–Line 2	Weapons Division
Address–Line 3	Point Magu, CA 93042-5001
Phone Number	805 989-9511
E-mail Address	mleczkd@magu.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	72
M&S Title	Integrated Theater Engagement Model (ITEM)
M&S Description	ITEM is an interactive computer simulation providing fully integrated air, land, and naval warfare engagement modules for the analysis of joint warfare operations in theater-level campaigns.
Environmental Factors	ITEM must consider day/night/weather factors that degrade combat effectiveness and detection ranges.
Organization	Space & Naval Warfare Systems Command
Point of Contact	Mr. Steve Brennan
Address–Line 1	Code 311-5
Address–Line 2	2451 Crystal Drive
Address–Line 3	Arlington, VA 22245-5200
Phone Number	703 602-1724]
E-mail Address	brennans@smtp-gw.spacwar.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	77
M&S Title	Integrated Training Interface (ITI)
M&S Description	The ITI will provide low-cost integrated surface ship and helicopter antisubmarine warfare (ASW) and Command and Control operational training.
Environmental Factors	The ITI will consider littoral issues.
Organization	Naval Surface Warfare Center
Point of Contact	Ms. Tamara Marasco
Address–Line 1	Indian Head Division
Address–Line 2	101 Strauss Ave
Address–Line 3	Indian Head, MD 20640
Phone Number	301 743-4173
E-mail Address	6520AD@SMTPhost.nosih.sea06.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	42
M&S Title	MIW Simulation Project (MARS)
M&S Description	End-to-end simulation of mine warfare, including MCM, mining, amphibious warfare, Marine Corps operations, and Navy Special Warfare.
Environmental Factors	Attenuation in blue-green band, wind speed
Organization	Coastal Systems Station
Point of Contact	Mr. David Demartino
Address–Line 1	Dahlgren Division, NSWC
Address–Line 2	6703 W. Hwy. 98
Address–Line 3	Panama City, FL 32407-7001
Phone Number	904 234-4830
E-mail Address	demartino_dave@ccmail.ncsc.navy.mil

Navy

E^{2}DIS Program Requirements Survey

M&S No.	32
M&S Title	Manned Flight Simulator (MFS)
M&S Description	Test & Evaluation, Training, and Man-in-the-Loop for ACETEF scenarios
Environmental Factors	Clouds, fog, haze, smog, visibility, and any other factors affecting a pilot's ability to perform the mission.
Organization	Naval Air Warfare Center - AD
Point of Contact	Mr. David Perdue
Address–Line 2	Patuxent River, MD 20670
Phone Number	301 826-7601

Navy

E^2DIS Program Requirements Survey

M&S No.	54
M&S Title	Naval Air Battle Evaluation Model (NABEM II)
M&S Description	The NABEM II simulation system provides a user-friendly, battleforce-level, Monte Carlo model of the anti-air warfare battle problem. The simulation will use generic algorithms to model or calculate system performance based upon user-defined characteristics and will provide similar fidelity to both offensive and defensive forces, allowing analysis of forces employed in either role.
Environmental Factors	Cloud cover, day/night
Organization	Naval Surface Warfare Center
Point of Contact	Mr. Dave Mayo
Address–Line 1	Carderock Division
Address–Line 2	Attn: Dave Mayo Code 212
Address–Line 3	Bethesda, MD 20084-5000
Phone Number	301 227-5232
E-mail Address	dave_mayo@sparc.dt.navy.mil

Navy

E^{2}DIS Program Requirements Survey

M&S No.	73
M&S Title	Naval Simulation System (NSS)
M&S Description	NSS will provide a unified modeling environment that will serve as a framework within which models can be assembled from objects and object components. The framework will provide consistent core services and tools to all Navy and Marine Corps modelers and simulators in support of acquisition, analysis, decision aids, logistics, and training.
Environmental Factors	None identified.
Organization	Johns Hopkins University
Point of Contact	Ms. Simone Youngblood
Address–Line 1	Applied Physics Laboratory
Address–Line 2	Johns Hopkins Rd.
Address–Line 3	Laurel, MD 20723
Phone Number	301 953-5000
E-mail Address	simone@aplcomm.jhuapl.edu

Navy

E^{2}DIS Program Requirements Survey

M&S No.	34
M&S Title	Research, Evaluation, and Systems Analysis (RESA)
M&S Description	Simulate the naval warfare environment to support command, control and communications; and computer and intelligence (C&I) research and development.
Environmental Factors	Impact of weather on carrier flight operations, and the impact of atmospheric conditions on sensor performance.
Organization	NCCOSC NRaD Code 44201
Point of Contact	Mr. Bill Lapp
Address–Line 1	Room 212
Address–Line 2	53140 Systems St.
Address–Line 3	San Diego, CA 92152-7555
Phone Number	619 553-3969
E-mail Address	1Knight@nosc.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	18
M&S Title	Space and Electronic Warfare Simulator (SEWSIM)
M&S Description	SEWSIM is a research and analysis tool for studying the effectiveness of current and projected own and enemy C3CM systems and procedures.
Environmental Factors	Impacts of weather on sensors, communications, propagation paths.
Organization	NCCOSC RDTE Div 773
Point of Contact	Mr. James Crowder
Address–Line 1	53150 Systems Street
Address–Line 2	Room 109
Address–Line 3	San Diego, CA 92152-7513
Phone Number	619 553-1009
E-mail Address	crowder@nosc.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	74
M&S Title	TBIP Mission Planning Performance Prediction
M&S Description	The purpose is to predict the probability of acquisition of TBIP I2R seeker for different targets in various environmental conditions.
Environmental Factors	Temperature, vector wind, humidity, precipitation, visibility, clouds (cover, type, and base), surface vapor pressure.
Organization	SAIC
Point of Contact	Mr. Mike Perry
Address	Arlington, VA
Phone Number	703 414-3810

Navy

E^2DIS Program Requirements Survey

M&S No.	30
M&S Title	TEMPAR (APL), EREPS, IREPS, RPO, and DCS (NCOSC)
M&S Description	All of these models are used to verify the performance of sensor systems in varying refractive environments.
Environmental Factors	Accurate and timely measurement of refractive conditions.
Organization	Naval Warfare Assessment Center
Point of Contact	Mr. Arron Jenkins
Address	Corona, CA 91718-5000
Phone Number	909 273-4862
E-mail Address	bray_william_p@dis.nnac.sea06.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	31
M&S Title	Tactical Advanced Combat Direction and Electronic Warfare, Environmental Generation and Control System (TACDEW EGCS)
M&S Description	TACDEW is a distributed shore-based computer system using array processors to generate tactical scenarios for shore-based crew training. TACDEW is capable of generating scenarios with up to 2,000 air, surface, and subsurface threat "tracks" simultaneously for as many as 22 exercises.
Environmental Factors	Clouds and wind, sea state, and ocean currents
Organization	Fleet Combat Training Center
Point of Contact	Lt David DelPadre
Address–Line 1	Atlantic Code N763
Address–Line 2	1912 Regulus Ave.
Address–Line 3	Virginia Beach, VA 23461-2098
Phone Number	804 433-7733

Navy

E^{2}DIS Program Requirements Survey

M&S No.	53
M&S Title	Tactical Aircraft Mission Planning System (TAMPS)
M&S Description	TAMPS is the system designated by the Navy for unit level planning. TAMPS will be used for mission planning for all aircraft, UAVs, and weapons except Tomahawk.
Environmental Factors	Requires real-time meteorological data and climatology
Organization	Naval Air Systems Command
Point of Contact	LCDR Zdenka Willis
Address–Line 1	Attn: LCDR Willis
Address–Line 2	1421 Jefferson Davis Hwy
Address–Line 3	Arlington, VA 22243-4448
Phone Number	703 604-4000
E-mail Address	willis.ntrprs@navair.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	01
M&S Title	Targetacq
M&S Description	Ground Target Acquisition Model
Environmental Factors	None, neither atmospheric nor near space data or their environmental effects are used.
Organization	The Center for Naval Analysis
Point of Contact	Dr. Michael Crecca
Address–Line 1	4401 Ford Ave.
Address–Line 2	Alexandria, VA 22302
Phone Number	703 824-2000

Navy

E^2DIS Program Requirements Survey

M&S No.	75
M&S Title	Tomahawk 6DOF Flight Simulation Model
M&S Description	The Tomahawk 6DOF Flight Simulation Model is a real-time model that simulates the flight characteristics of Tomahawk missions from power up to target impact. It can be modified to simulate similar missiles. Required environmental information includes vertical atmospheric profiles for standard day, polar day, and tropical day; and a simple wind model.
Environmental Factors	Wind profiles and weather changes along flight path.
Organization	NSWC/IHD
Point of Contact	Mr. Robert Diddeu
Address–Line 1	Attn: Robert Diddeu, Code 6540
Address–Line 2	101 Strauss Ave.
Address–Line 3	Indian Head, MD 20640-5053
Phone Number	301 743-4173
E-mail Address	6540x@smtphost.nosih.sea06.navy.mil

Navy

E^2DIS Program Requirements Survey

M&S No.	50
M&S Title	Tropospheric Propagation Model
M&S Description	A model to determine RF propagation bending and time delay to improve tracking accuracy and ephemeral/Doppler accuracy, and to simulate meteorological data to produce related information and ray-tracing for various characteristics.
Environmental Factors	Hourly and daily atmospheric data such as pressure, temperature, relative humidity, etc. from the surface to 30 km by layer.
Organization	US Naval Research Lab
Point of Contact	Mr. Junco Choi
Address	Code 81402, Washington, DC
Phone Number	202 767-9050

Navy

E^{2}DIS Program Requirements Survey

M&S No.	40
M&S Title	Weapons Analysis Facility (WAF)
M&S Description	The WAF is the Navy's most advanced real-time hardware-in-the-loop underwater systems simulator, which guides the development and evaluation of undersea weapons and countermeasures. It provides a platform to evaluate weapon systems performance under realistic, littoral warfare conditions.
Environmental Factors	None identified.
Organization	Naval Undersea Warfare Center
Point of Contact	Mr. Ernest Correia
Address–Line 1	Code 8421
Address–Line 2	Newport, RI
Phone Number	401 841-3103
E-mail Address	correiae@wpn.npt.nuwc.navy.mil

APPENDIX G

LIST OF MODELS AND SIMULATIONS

WITH OCEAN REQUIREMENTS

Service or Agency	Titles of Models/Simulations
Army:	1. Communications-on-the-Move Radio Model (CMRM) 2. Logistics-Over-the-Shore Site Selection (LOSSS) 3. Logistics-Over-the-Shore Throughput Planner (LOTSTP) 4. Mounted Warfare Test Bed (MWTB) 5. Transportation Infrastructure Assessment (TIA) 6. Warfighter Simulation (WARSIM) 2000
Navy:	1. AEGIS AN/SPY-1A/B/D Firm Track Simulation 2. AEGIS Radar System Controller Environmental Simulation (RSCES) 3. Chemical/Biological Agent Vapor, Liquid, and Solid Tracking (VLSTRACK) 4. Combat System Engineering & Analysis System (CSEAL) Simulation System (CSS) 5. Combat Systems Multi-Warfare Tactical Scenarios (CSMWTS) 6. Composite Warfare Model (CWM) 3.4.0 7. Cruise Missile Mission Planning and Weapon Control Systems: Tomahawk Land Attack Missile (TLAM) 8. Enhanced Naval Warfare Gaming System (ENWS) 9. Enhanced Naval Warfare Gaming System (ENWGS) 10. F-14D Training System 11. Helmet-Mounted Mission Rehearsal Simulation System (HMMRSS) 12. Integrated Radar and Infrared Analysis and Modeling (IRIAM) System 13. Integrated Theater Engagement Model (ITEM) 14. Integrated Training Interface (ITI) 15. Manned Flight Simulator (MFS) 16. Mine Warfare Simulation Project 17. Naval Air Battle Evaluation Model (NABEM II) 18. Naval Simulation System (NSS) 19. Research, Evaluation, and Systems Analysis (RESA) 20. Space and Electronic Warfare Simulator (SEWSIM) 21. Tactical Advanced Combat Direction and Electronic Warfare Environmental Generation and Control System (TACDEW EGCS) 22. Tactical Aircraft Mission Planning System (TAMPS) 23. TEMPER (APL), EREPS, IREPS, RPO, and DCS 24. Tomahawk Baseline Improvement Program (TBIP) Mission Planning Performance Prediction 25. Tomahawk 6DOF Flight Simulation Model 26. Weapons Analysis Facility (WAF)
Marine Corps:	1. Direct Forward Observer/Modular Universal Laser Engagement (DFO/MULE) 2. Environmental Effects on Sensors (EES) 3. MAGTF Tactical Warfare Simulator (MTWS) 4. Manuever Warfare Analytical Research System (MWARS) 5. Team Target Engagement Simulator (TTES)

Service or Agency	Titles of Models/Simulations
Air Force:	1. A/F 37A-T84 F-15 Weapon System Trainer 2. Advanced Electro-optical Model for Aerial Targeting (AE*MAT) 3. Contingency Theater Automated Planning System (CTAPS) 4. Mission Environmental Requirements Integration Technology (MERIT) 5. Satellite Assessment Center (SATAC) 6. SOF Aircrew Training System (ATS)/SOF Training & Rehearsal System (TARP) 7. Space Surveillance Network Tracking Error (SSNTE) Model
Advance Research Project Agency:	1. Synthetic Theater of War (STOW)
Coast Guard:	1. Computer Assisted Search Planning (CASP) 2. HH-60J Flight Trainer

APPENDIX H

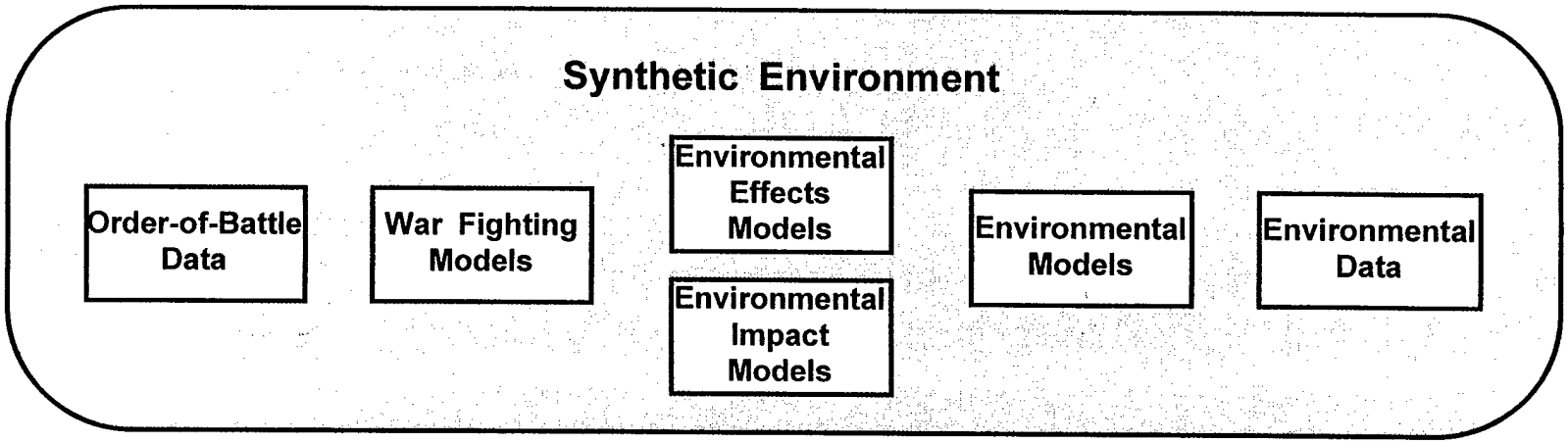
MAJOR COMPONENTS

OF

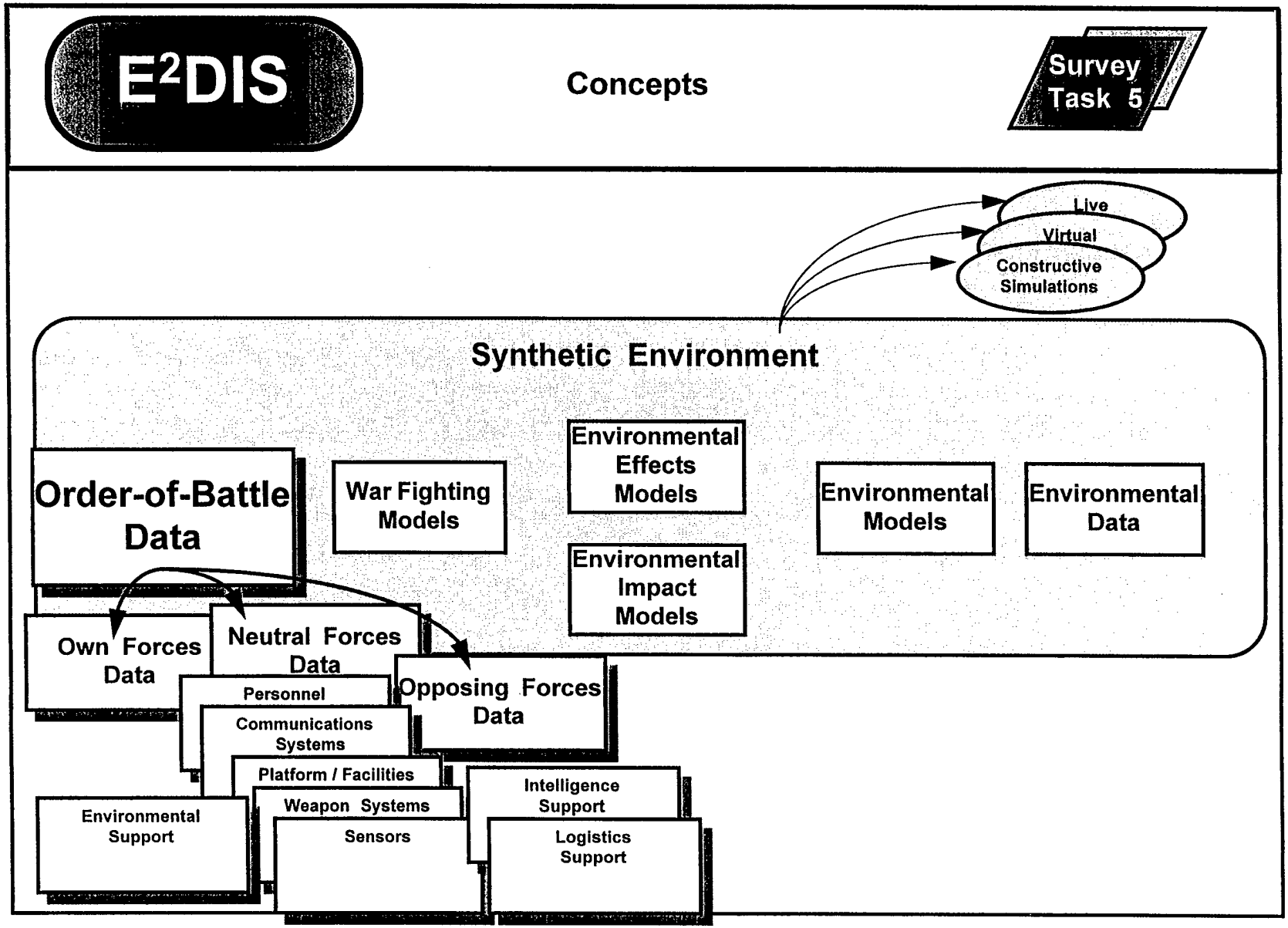
MILITARY MODELS AND SIMULATIONS

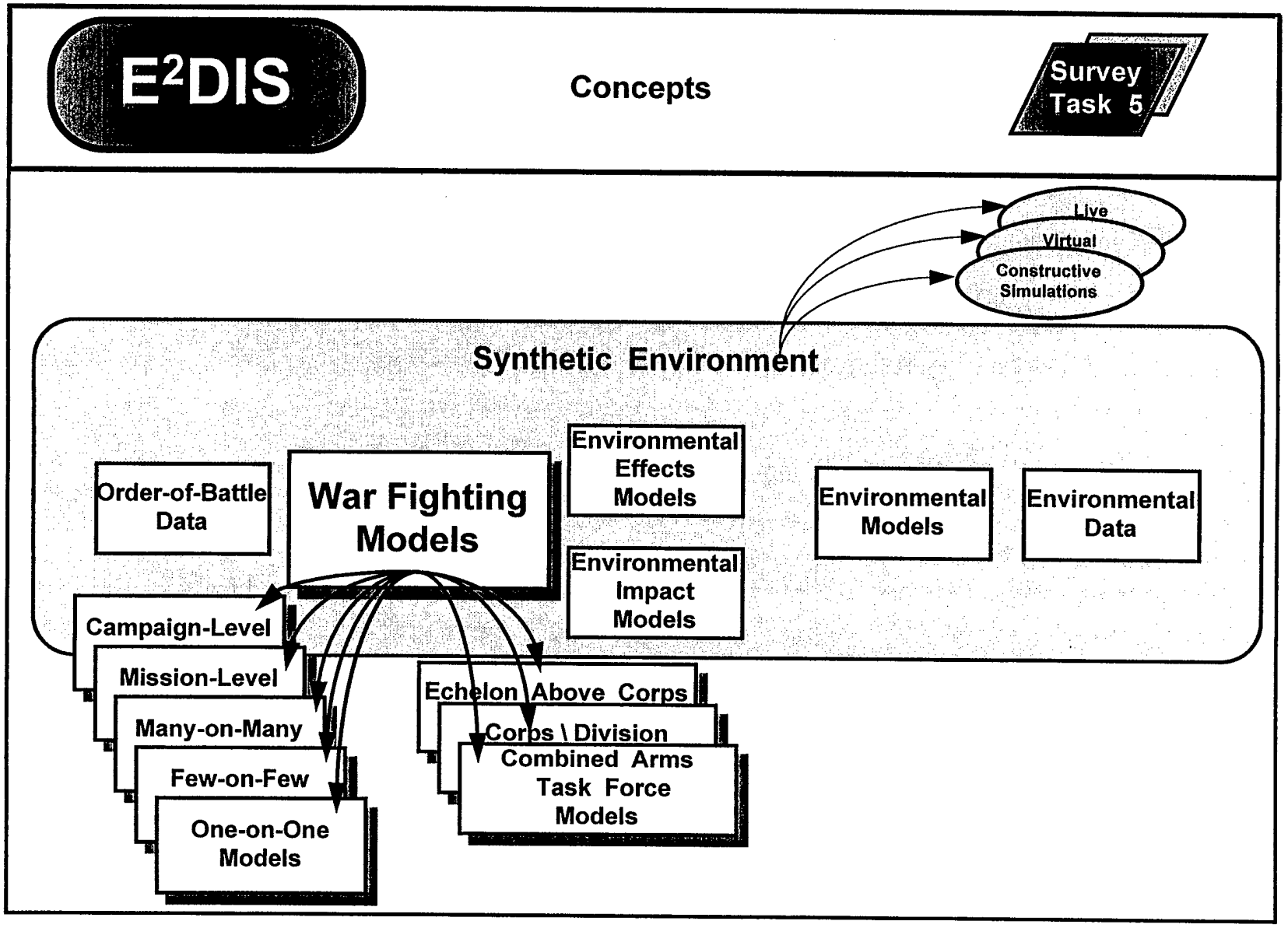
War Fighting Simulations:

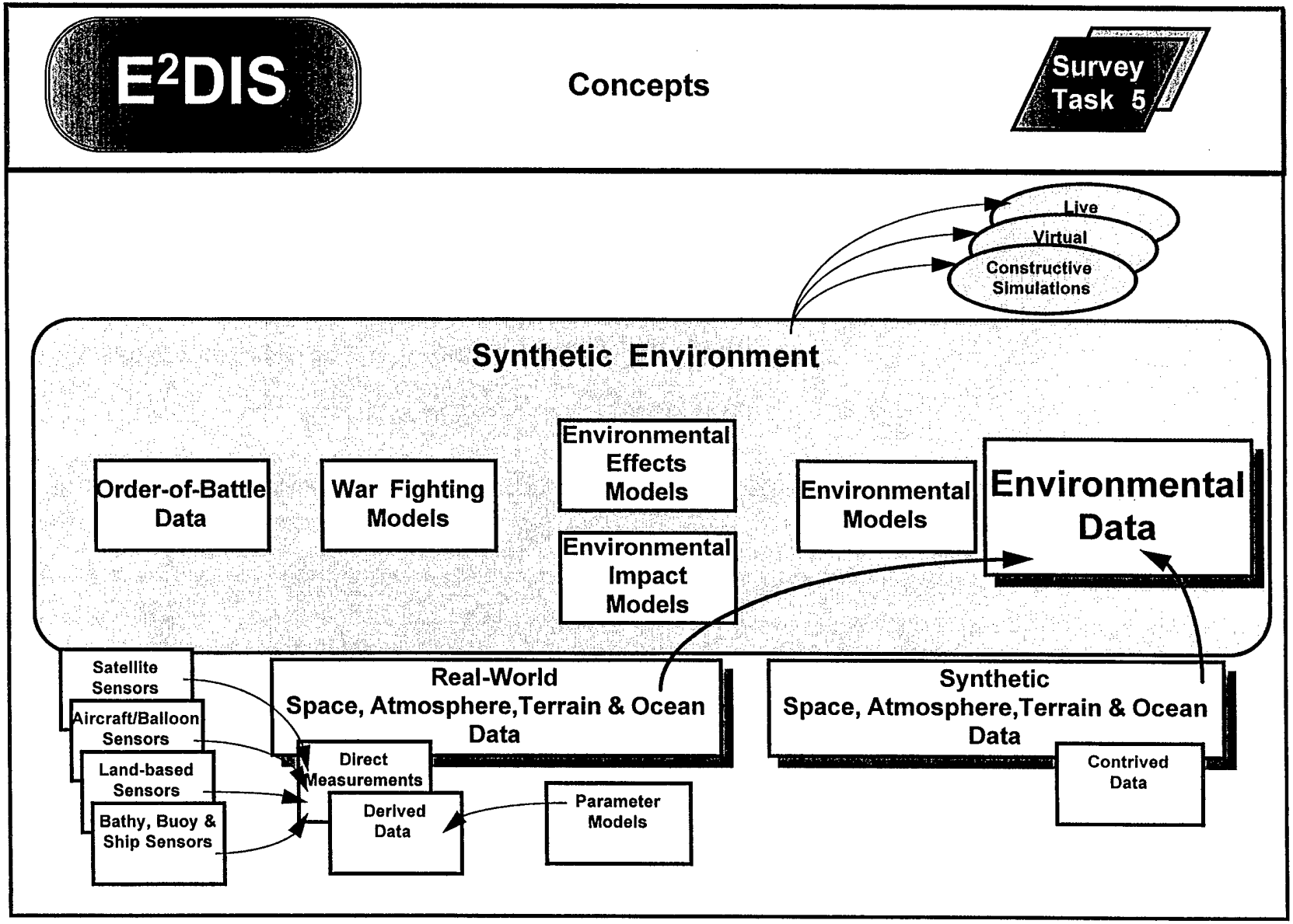
War Fighting Models and Environmental Effects and Impact Models

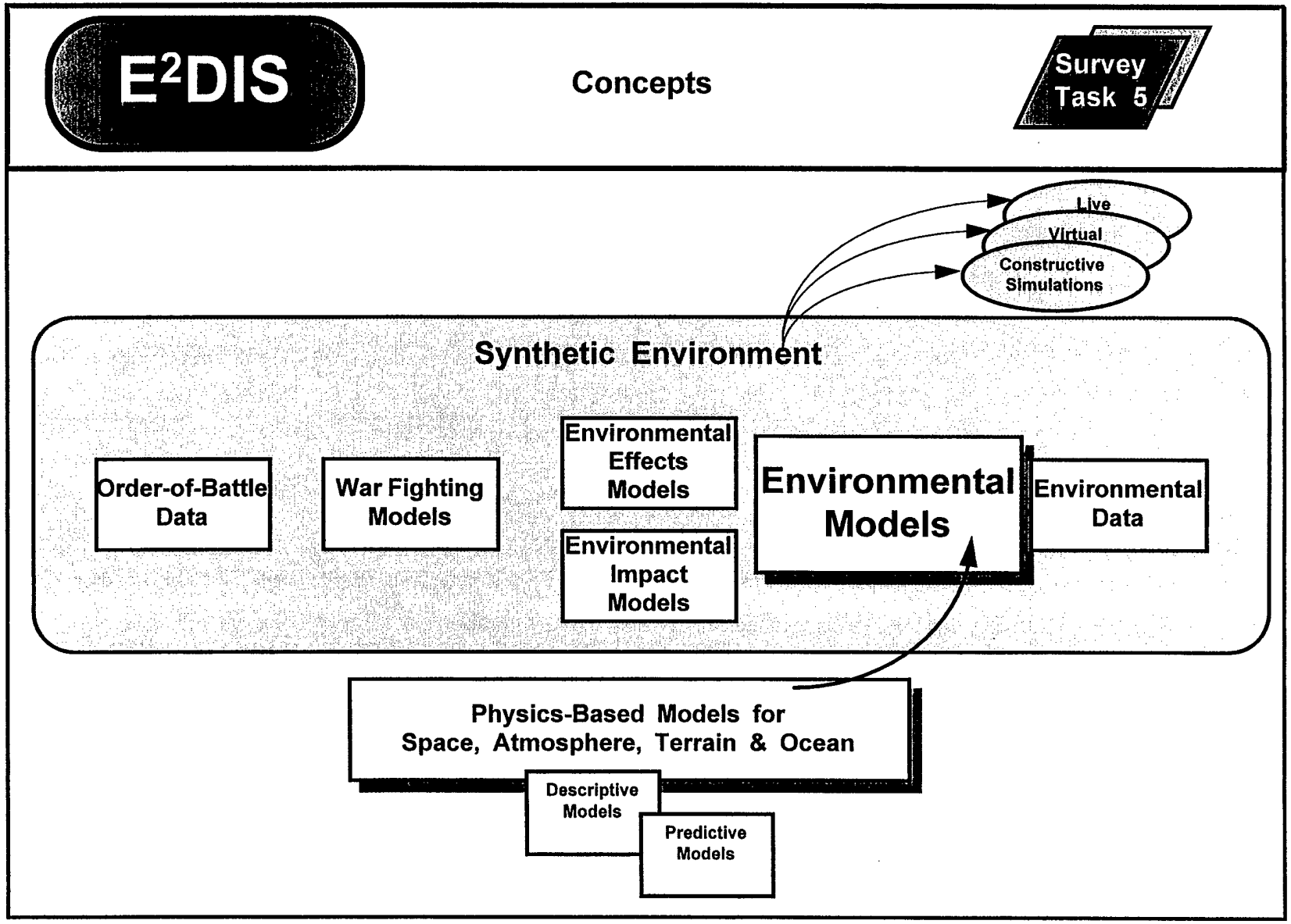


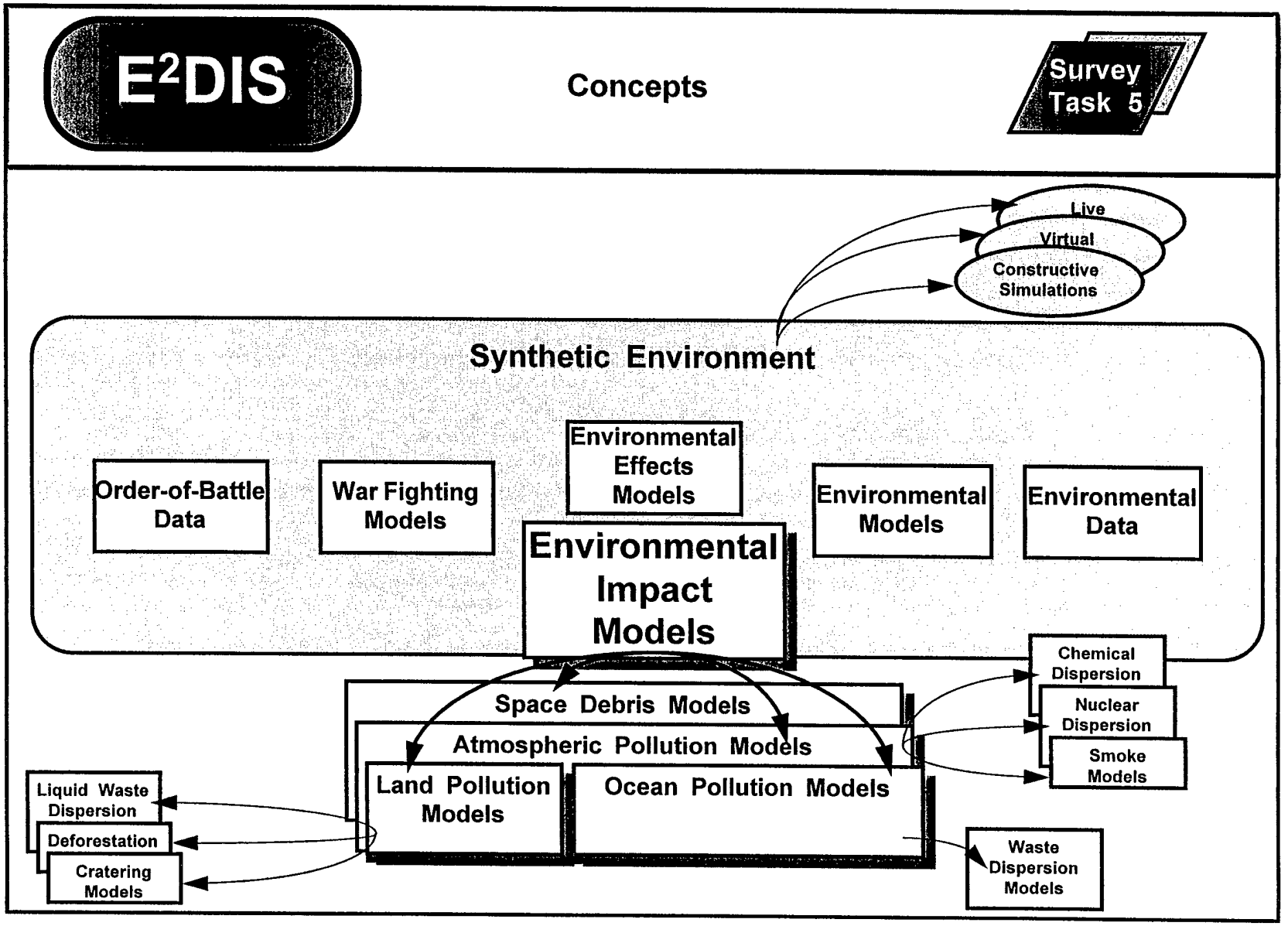
Are Dependent Upon Supporting Models and Data.

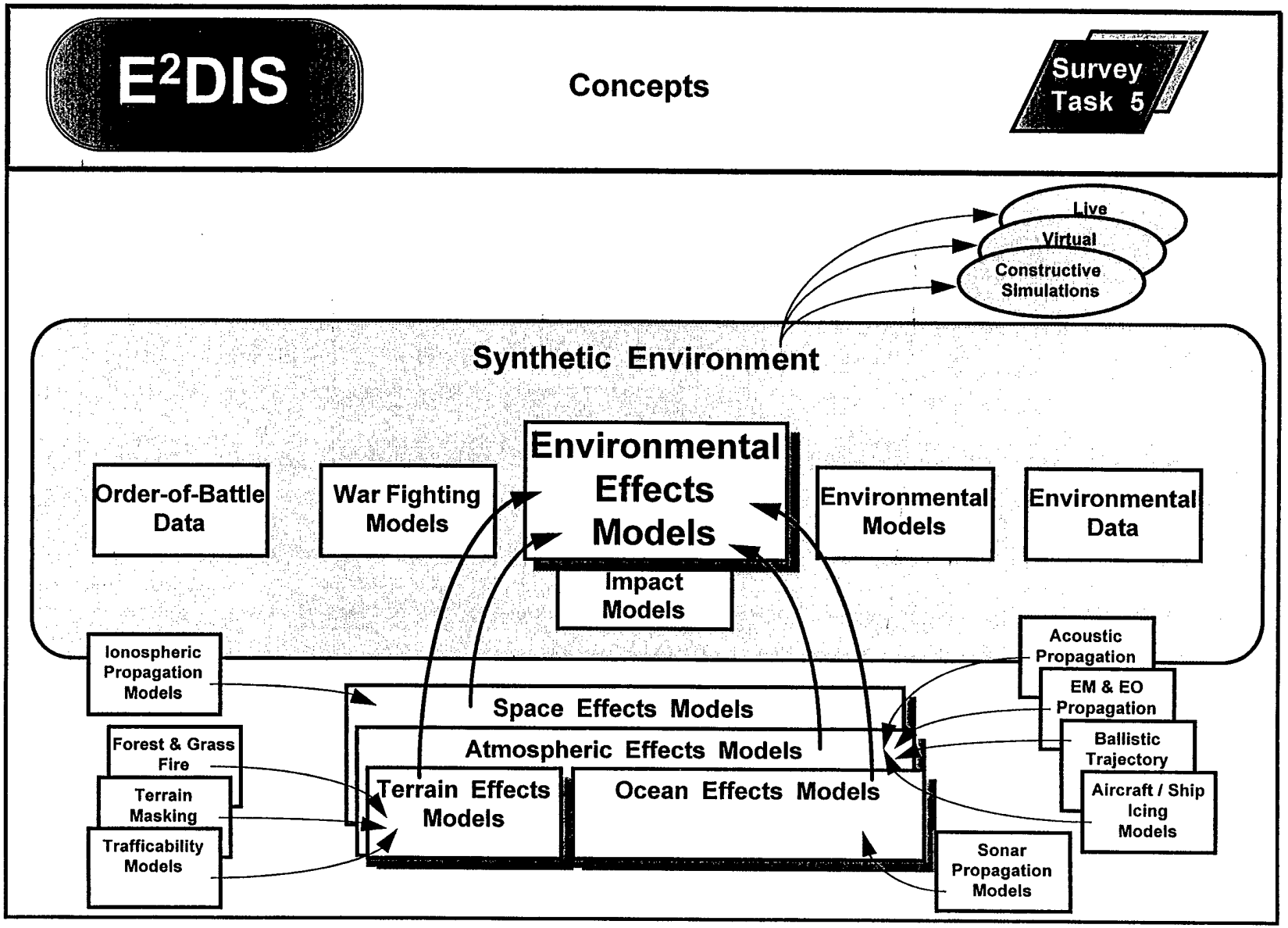

E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Environmental Impact Models
Environmental Models
Environmental Data
Own Forces Data
Neutral Forces Data
Opposing Forces Data
Personnel
Communications Systems
Platform / Facilities
Weapon Systems
Sensors
Environmental Support
Intelligence Support
Logistics Support


E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Environmental Impact Models
Environmental Models
Environmental Data
Campaign-Level
Mission-Level
Many-on-Many
Few-on-Few
One-on-One Models
Echelon Above Corps
Corps \ Division
Combined Arms Task Force Models


E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Environmental Impact Models
Environmental Models
Environmental Data
Satellite Sensors
Aircraft/Balloon Sensors
Land-based Sensors
Bathy, Buoy & Ship Sensors
Real-World Space, Atmosphere,Terrain & Ocean Data
Direct Measurements
Derived Data
Parameter Models
Synthetic Space, Atmosphere,Terrain & Ocean Data
Contrived Data


E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Environmental Impact Models
Environmental Models
Environmental Data
Physics-Based Models for Space, Atmosphere, Terrain & Ocean
Descriptive Models
Predictive Models


E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Environmental Impact Models
Environmental Models
Environmental Data
Space Debris Models
Atmospheric Pollution Models
Land Pollution Models
Ocean Pollution Models
Chemical Dispersion
Nuclear Dispersion
Smoke Models
Liquid Waste Dispersion
Deforestation
Cratering Models
Waste Dispersion Models


E²DIS
Concepts
Survey Task 5
Live
Virtual
Constructive Simulations
Synthetic Environment
Order-of-Battle Data
War Fighting Models
Environmental Effects Models
Impact Models
Environmental Models
Environmental Data
Ionospheric Propagation Models
Forest & Grass Fire
Terrain Masking
Trafficability Models
Space Effects Models
Atmospheric Effects Models
Terrain Effects Models
Ocean Effects Models
Acoustic Propagation
EM & EO Propagation
Ballistic Trajectory
Aircraft / Ship Icing Models
Sonar Propagation Models